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Notes on the Cuyuna Range—I

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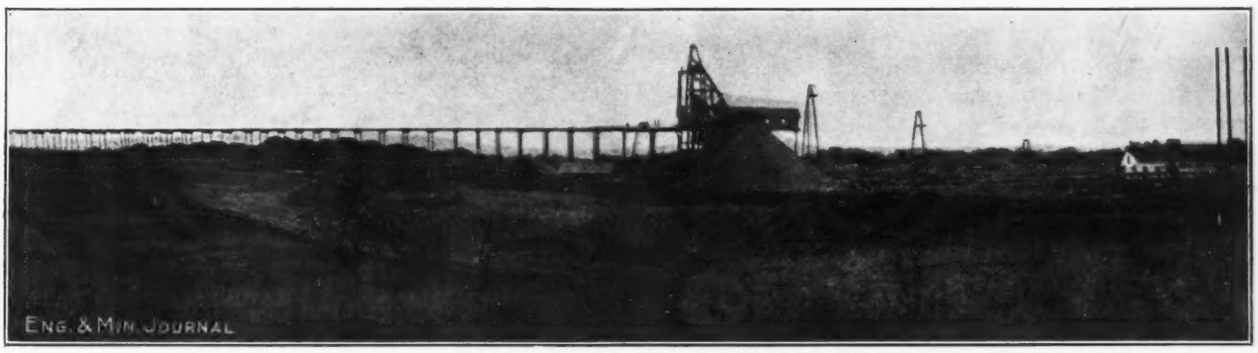
SYNOPSIS—Description of present conditions and practice on the Cuyuna iron range in Minnesota. Location, geology and discovery noted.. Methods of exploration and drilling. Descriptions of the operating companies. Mining methods and typical equipments considered. Water, concentration and transportation problems discussed.

The Cuyuna, the newest of the Minnesota iron ranges, lies in the central part of the state, south and west of the Mesabi, covering an area perhaps 50 miles long and of varying width. The fact that the ore occurs in highly inclined lenses relatively small but extremely numerous, that for the most part it is commercially a hard ore, that the country is flat and overlain by an unusually heavy mantle of drift so that ore never outcrops and rock only rarely, that some of the ore is high in manganese, that water is a serious problem, these characteristics serve to differentiate the Cuyuna from the other Lake Superior ranges and together with its recent development and still unproved extent make it of great present interest.



Armour No. 2 Headframe and Trestle

Subdivisions

The district is usually considered as made up of two parts, the north range and the south range. The general strike of the formation, as well as of the individual lenses, is about N. 50° E. Two strong lines of magnetic attraction extending the whole length of the district indicate the orebodies that constitute the south range. On the northwest side of these lines, at the northeast end, several shorter parallel lines of attraction outline the north range. The north range was the first developed and is the principal producer still. It is claimed that the ore goes deeper there than on the south range. The most important place and the geographical center of the whole range, as outlined by the lines of attraction, is the city of Brainerd. Crosby, a recent settlement, is the principal town on the north range. Deerwood, Ironton, Cuyuna, Riverton, are other towns of some importance, usually closely connected with individual mines or groups. The principal producing mine is the Kennedy on the north range. The Barrows is the only producer as yet on the south range.

Geology

It is not within the scope of this article to give in detail the history and geology of the district. The ore occurs as lenses, having their greatest dimension along the strike, the next greatest down the dip and the least dimension at right angles to these. The dip will vary from 45° to almost 90°. The country rock is either igneous or metamorphic, the walls being prevailingly a slate. An increasing importance is now being attributed to the igneous rocks. The country seems to have been much folded, which accounts for the repeated occurrence of the ore formation over a considerable distance at right angles to the strike. The ore has been derived from iron carbonates and silicates by natural concentrating processes. In some cases the original iron minerals have been metamorphosed to magnetite by the igneous intrusions and have suffered no further concentration. The areas where this has taken place show strong attraction but no ore.

In fact, the orebodies themselves show little attraction and the lines of attraction are the result of associated magnetic rocks. A strong attraction is a good sign of ore, but is not invariable nor is its absence always proof of the absence of ore. An account of the geology of the range can be found in Monograph LII of the U. S. Geological Survey, by Leith, Van Hise and associates. While

*Of editorial staff, "Engineering and Mining Journal."

not strictly uptodate, there have been no radical changes in the conception of the geology since its publication.

The economic mineral is principally hematite. In some ores large amounts of manganese occur. The following are typical complete analyses, the averaged results of a number of samples on three north range properties:

TYPICAL ANALYSES OF CUYUNA ORES

	Mine No. 1	Mine No. 2 Foot-Wall Side	Mine No. 2 Hanging-Wall Side	Mine No. 3
Fe	56.80	61.31	58.78	61.88
P	0.275	0.295	0.22	0.066
SiO_2	8.80	4.49	6.41	8.09
Mn	0.30	0.44	0.35	0.37
Al	1.73	2.52	2.70	2.28
Ca	0.17	0.11	0.13	0.04
Mg	0.12	0.06	0.10	0.03
Ignition loss	4.65	6.64	7.47	1.19
Moisture	11.25	.....	.....	.....

Discovery and Development

Mention of variation in the direction of the compass needle is found in the notes of the government land surveyors who worked through the country in the '70s. Grave suspicions were raised as to the presence of iron ore by the behavior of the compasses when the Northern Pacific ran the surveys for its present road. Cuyler Adams developed a belief in the possibilities of the district as a source of iron and began a period of investigation and surveying which extended over five years. At the end of that time he started to pick up land at prices that now look absurd. He paid $4 per acre for the land now constituting the Kennedy mine and all his extensive purchases stand him in only about $10 per acre. It is difficult to state the value of these lands today.

Mr. Adams can walk from Deerwood to Brainerd on his own property, most of it ore-bearing. This is one refreshing case where the reward for a new discovery has gone to the man most deserving it. Mr. Adams' success in bringing in the range as a producer was obtained only in the face of many difficulties. His ideas were scoffed at, his holdings were repeatedly drilled and turned down, but he had sufficient persistence and faith to win out.

Exploration and Drilling

Preliminary exploration of a tract of land is performed with a dip needle. By this means the lines of strong magnetic attraction are discovered and plotted. The next operation in exploration is drilling. At first, Mesabi practice was followed, a given 40 being drilled over its entire area with holes regularly spaced at intervals of a few hundred feet. The attempts to use this method were largely responsible for the early discouraging reports on the range. It was extremely easy to miss the ore altogether. When the nature of the occurrence of the ore-bodies because better understood, a more suitable method was evolved. The line of attraction across a 40 being determined, four or five equally spaced points are established along its length and along a line at right angles through each point a series of holes is put down. This operation is called "cross-sectioning." The spacing of these holes is variable, but will average 40 to 50 ft. The holes may be vertical or inclined; the latter offer the advantage of intersecting the oppositely dipping formation more squarely and thus giving the same amount of information with less drilling; an incidental advantage is that they are less likely to be deflected by failing to enter a hard stratum at a sharp angle; they are, however, somewhat more expensive and difficult to drill. The choice between vertical and angle holes seems to be to a certain extent a question of locality. The north range formation is flatter, averaging about 60°, a condition more favorable to the vertical hole, and at present, so far as could be discovered, only vertical holes are there being put down. On the south range the dip is about 75°, so that an angle hole shows an increased advantage, and there are several now being drilled.

Drilling through the surface drift is done with a churn drill, of the Lake Superior pattern. In the softer rocks, the churn drill is also available, but for hard formation the diamond drill is more efficient. Accurate logs are kept of the drilling and sampling is carefully done when in ore. The work is for the most part carried on by contractors, there being one large company, the Longyear, and many smaller concerns in the field. Any drill runner is a potential drilling contractor, depending on his ability to get hold of a rig. The holes in the overburden of drift are cased with a 3-in. pipe and in the rock with a 2-in.

Extent of District and Mining Operations

At present, while much drilling has been done, the limits of the district both in lateral extent and in depth are still undetermined. The deepest ore has been found on the north range. At a point about a mile east of Riverton the Carlson Exploration Co. put down a hole for 1017 ft. and bottomed it in material running 35% in iron. At slightly higher points a better grade was penetrated. In the Armour No. 1 ore has been found at 700 ft. and in the Pennington at 750 ft. On the other hand, some of the mines have been bottomed at from 300 to 400 ft. The chances of eventually finding a good deal of ore in depth would to an outsider seem to be excellent.

There are at present three points of activity on the south range, the Barrows mine, which recently began shipping, the Brainerd-Cuyuna shaft, being put down in Brainerd itself, and the Adams mine, of the Orelanis Mining Co., which is cutting its pump station and preparing for extensive mining. The Barrows mine, in a way, marks the southwest end of the range, although drilling has been carried on beyond it and the lines of attraction extend far beyond it. It is operated by the Virginia Ore Mining Co., a subsidiary of the M. A. Hanna Co. The mine is now hoisting about 200 tons with a single skip, but a new five-compartment shaft has been started. Considerable water has to be handled, about 200 gal. per min. at present.

Brainerd-Cuyuna Mine

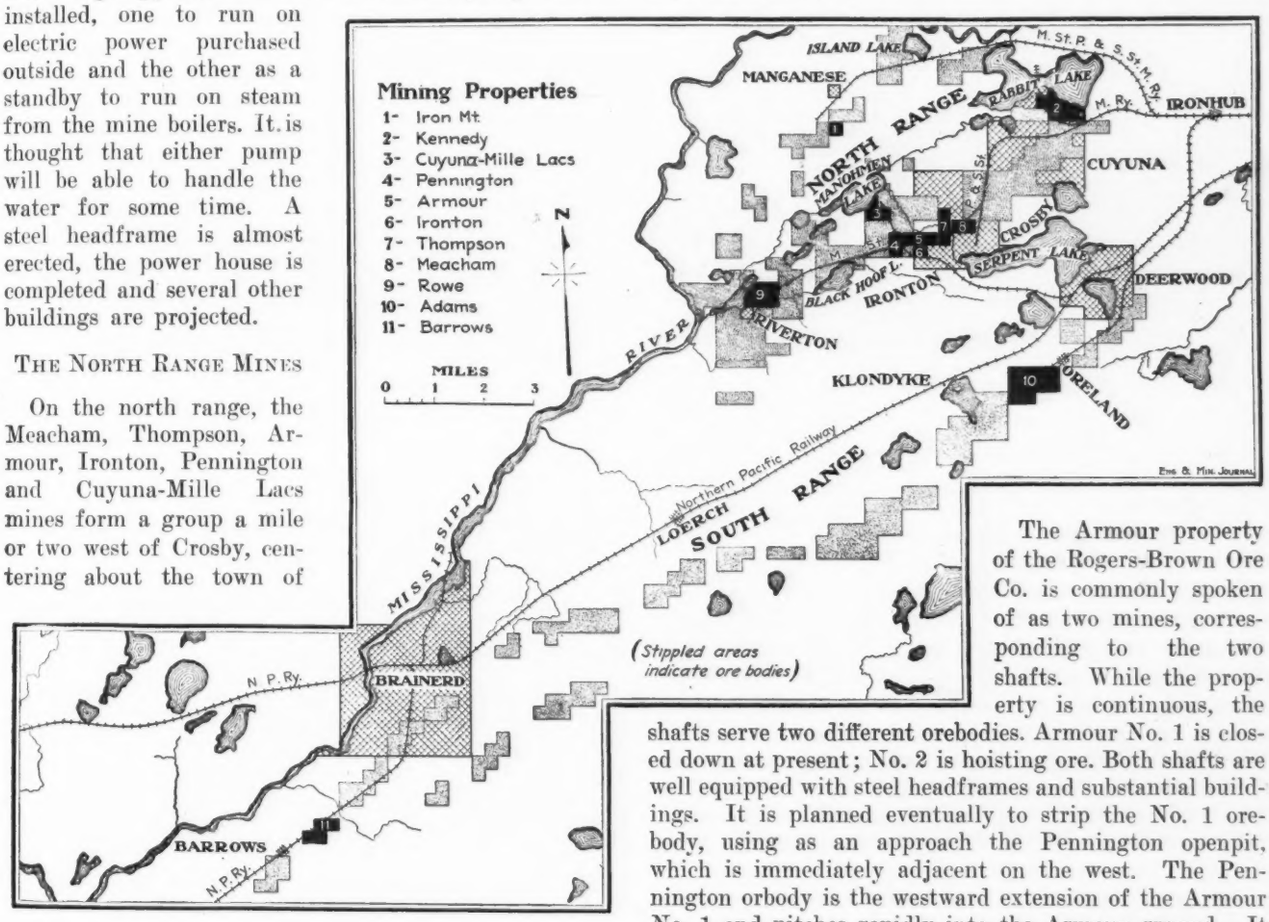
The Brainerd-Cuyuna shaft in the south end of the city of Brainerd is being sunk to mine a fair-sized body of ore. Part of a churn-drilling outfit is used for the preliminary sinking and seems to be rather a good rig for the purpose. The engine, tripod and a hemp rope are employed. The drilling engine has an oscillating cylinder and no crosshead; the hoisting rope is given several wraps around the projecting capstan head and the operator keeps pulling off the loose end as the rope is wound on and the bucket hoisted. The contents of the bucket are dumped into a wheelbarrow and wheeled away. At the time of visiting, the shaft was down about 40 ft., was timbered with 12x12-in. sets and was making little water. It is to be hoped that the last favorable condition continues.

Adams Mine

The Adams mine, while on the south range, is geographically more closely connected with the north range mines, being only three or four miles south of Crosby. Cuyler Adams himself is directing operations here, and takes great pride and interest in the work. He has had put down a 137-ft. concrete drop shaft at considerable expense to him and more to the shaft contractor; he is installing his plant with great care and foresight and intends to make the shaft a central point for mining operations covering two or three miles along the strike. The pump station is being cut in hard, dry diabase and is also being supported with steel sets. Two pumps will be installed, one to run on electric power purchased outside and the other as a standby to run on steam from the mine boilers. It is thought that either pump will be able to handle the water for some time. A steel headframe is almost erected, the power house is completed and several other buildings are projected.

The North Range Mines

On the north range, the Meacham, Thompson, Armour, Ironton, Pennington and Cuyuna-Mille Lacs mines form a group a mile or two west of Crosby, centering about the town of Ironton. To the northeast is the Kennedy, to the northwest the Iron Mountain and to the west, the Rowe, the Kennedy, Armour, Pennington, Ironton and Cuyuna-Mille Lacs are producing; the Meacham is closed down; the Thompson and Rowe are stripping and the Iron Mountain is developing.



Map of the Cuyuna Iron Range

The Thompson, of the Inland Steel Co., was first opened up as an underground mine in the face of a heavy flow of water. The flow at one time was 3500 gal. per min. and the country was drained for a long area around. The water is now choked back with dams and bulkheads and some of the neighboring properties allowed to fill again. Underground development comprises about a mile of workings, the lowest level being the 250-ft. At present all underground work is suspended and the property is being stripped. The orebody is about 1400 ft. long and the crest of the pit will be about 350 ft. across. The average depth of overburden is 70 ft. The company expects to steam shovel about 70 ft. of the ore after stripping and then to mill about 80 ft. The milling and subsequent underground mining will bring into use again the concrete shaft and its steel headframe, the shaft being used practically for pumping only while steam-shovel work is being carried on. The Thompson has another orebody of probably lower grade on which less work has been lone.

The Armour property of the Rogers-Brown Ore Co. is commonly spoken of as two mines, corresponding to the two shafts. While the property is continuous, the shafts serve two different orebodies. Armour No. 1 is closed down at present; No. 2 is hoisting ore. Both shafts are well equipped with steel headframes and substantial buildings. It is planned eventually to strip the No. 1 orebody, using as an approach the Pennington openpit, which is immediately adjacent on the west. The Pennington orbody is the westward extension of the Armour No. 1 and pitches rapidly into the Armour ground. It will be possible after stripping to mine a fair amount of the orebody with the steam shovel and the deeper portion to the east can then be taken out by continuing an inclined adit from the openpit. The Armour No. 1 has developed the 300-ft. level rather thoroughly.

The Pennington Openpit

The Pennington mine is in many ways the most interesting in the district, chiefly as being the first property to be stripped and mined with a steam shovel. The Pennington Mining Co. is controlled by the Tod-Stambaugh interests. Working under conditions, some of which were favorable and others unfavorable, the property was stripped at a remakably low cost per cubic yard. The figure commonly given is 9c.; it is not certain, however, just what items are included in this cost.

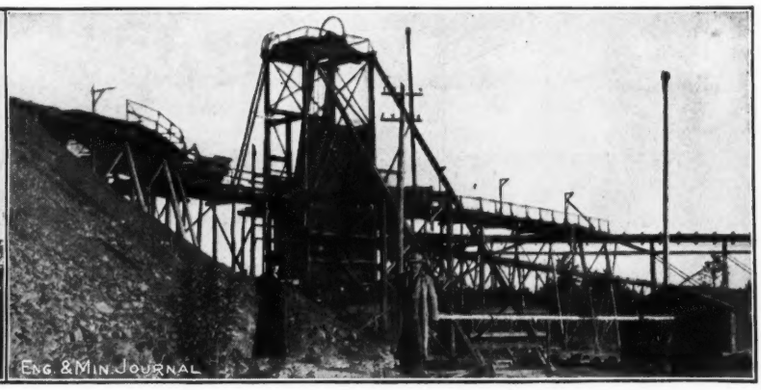
The most favorable condition governing the work is the character of the overburden, which is a glacial drift,

chiefly sand, uncompacted, dry and free of large boulders. It is almost ideal material for a shovel to handle; no blasting is required. Unfavorable conditions are the facts that the deposit is long and narrow, that the grades both for stripping and for mining are extremely steep and that the curves are sharp. Furthermore, it was necessary to make a supplementary cut at right angles to the pit in order to get a grade that was at all feasible. This, of course, added to the quantity of overburden removed. The distance from the pit to the end of the dump is 4000 ft., of which 1000 ft. is on a 6% grade and 3000 ft. on a 3%, giving a total difference in elevation to be overcome of 150 ft. The maximum grade is 7% and this, furthermore, occurs on a 23° curve. The overburden removed amounted to 1,250,000 cu.yd., the average depth being 70 ft. It is expected to mine 60 ft. of the ore with the steam shovel and to mill 50 ft. Milling and the final underground work will, of course, necessitate a shaft, which the company does not possess at present. The ore is in a series of parallel lenses so close together that the poor material separating them is not in sufficient quantity to lower the grade of the ore below merchantable limits.

LOOKING EAST IN PARTLY STRIPPED THOMPSON PIT

HEADFRAME AND SHAFT HOUSE OF THE KENNEDY MINE

ADAMS POWER HOUSE, CONCRETE STACK, STEAM AND AIR LINES TO SHAFT



BARROWS HEADFRAME WITH STOCK PILE ON LEFT AND TRESTLE AND LAUNDERS ON RIGHT

THE LOCKER-DONAHUE PROPERTIES

The Ironton mine of the Cuyuna-Duluth has been opened to get out a small portion of the Armour No. 2 orebody, which extends through one corner of the 40 held by the company. The mine is equipped with a wooden headframe and hoists with one skip. About 5000 tons has been mined this year, but the property must necessarily be a small one. The working level is the 200-ft.

The Cuyuna-Mille Lacs mine, to the northwest about a mile, is controlled by the same interests as the Cuyuna-Duluth, the Locker-Donahue. It is chiefly noteworthy for the high manganese content of its ore. About 30,000 tons have been shipped this year to various concerns, including the Bethlehem Steel Co., the Pittsburgh Steel Co., the Standard Iron Co., the Lake Superior Iron & Chemical Co., etc. This has been largely low-manganese material. Ore running 8 to 15% in manganese is used for making a basic pig, that running from 15% to 30% is suitable for spiegel and that above 30% for ferromanganese. The analyses of a recent shipment of ten cars ran from 41% to 50% in iron, from 0.025% to 0.033% in phosphorus and from 11.15% to 17.21% in manganese. Underground work is now being carried on, the 200-ft. being the working level, but it is intended eventually to strip the orebody. The company claims reserves of 10,000,000 tons and of this 1,500,000 is said to be well blocked out. One 440-ft. and several 350-ft. holes were stopped in ore. Ore has been found by drilling over a width of 600 ft. The overburden is from 50 to 70 ft. deep.

THE ROWE MINE

The Rowe mine of the Pittsburgh Steel Ore Co. lies about six miles from Crosby to the west, adjoining the town of Riverton. It is particularly interesting for the hydraulic stripping which is being done. The overburden has been partly sluiced off and partly broken down with a hydraulic giant and pumped off. A steam shovel has also recently been added, to expedite matters. The ore which is being stripped is said to lie in two bodies, that to the north of higher grade than the other. A consider-

able tonnage is known to exist, but the grade is variable and it is commonly believed that most or all of it will have to be concentrated. The results of experiments along this line are said to have been favorable.

The Iron Mountain is a small outlying property that has just got a shaft into the ledge after having had considerable difficulty in sinking attempts.

The Kennedy

The best mine of the district at present is the Kennedy, of the Rogers-Brown company. It will probably produce about a quarter of a million tons this year. Underground mining only is practiced and operations have had time to become somewhat systematized. The mine has the distinction of having been emphatically turned down by one large company after a thorough drilling. It happened that the holes were all put down at an inclination parallel to the orebodies and never got out of the foot wall.

Great difficulty was had in getting a shaft down to the rock when the Rogers-Brown company took hold and attempted to sink. Several shafts have been sunk, only the last one being used for hoisting and pumping. The mine is opened up on two levels, but the upper of these is called a sublevel and no ore is hoisted from it. The ore is mined by a top-slice method; rooms about 30x40 ft. are cut out and timbered temporarily; then the timbers are blasted out to permit the overburden to cave down. A mat of timbers is formed to keep the overburden from the ore. In some cases a slice is taken out so as to leave 10 ft. of ore between the top of the room and the overburden and then this is caved.

The general method is similar to that followed on the Mesabi, but the timbering is somewhat different, the posts of the sets being battered and the sets themselves placed somewhat irregularly. The mine is opened up on four ore lenses, the South, the Intermediate, the Midway and the North, which converge toward the northeast and are thought to come together under Rabbit Lake. Of these the Intermediate is the richest and the most productive. The Midway has been little developed. The North and South have been opened up to a considerable extent but are of lower grade than the Intermediate. Some apprehension is felt as to the possibility of Rabbit Lake's coming in on the mine. An impervious band of clay protects the mine from seepage, but lines have been established parallel to the lake shore beyond which mining is not permitted. The mine is 262 ft. deep, this being the lowest level, but has not been bottomed as all the drill holes were shallow.

Operations and Equipment

The ore is shot down crib chutes to the bottom level, trammed to the shaft and hoisted. An electric tramming system is being installed. A new stock-pile trestle, 1100 ft. long, is under construction on the surface to take care of the winter's production. This is of unusual length but only the outer half can be used, as it is not considered wise to stock the ore over the underground workings. The mine makes a large quantity of water which is handled with a cross-compound, condensing Prescott, corliss steam pump, Mesabi pattern. As a standby there is a centrifugal pump direct connected to a condensing steam turbine. The headframe is of steel and the numerous other buildings are substantially constructed.

Wallaroo & Moonta

The Wallaroo & Moonta Mining & Smelting Co., South Australia, for half-year ended June 30, 1913, shows a production of 3610 tons of refined copper from 35,456 tons of ore, matte and precipitates smelted. The following table shows the tonnage of ore produced and men employed:

	Tons	Men Employed	Tons per Man (6 Mo.)
Wallaroo mines	29,324	1071	27.40
Moonta mines	3,080	278	11.1
Smelting works	35,456	307	114

The ore from the Wallaroo mines averaged 8.24% copper and in addition to the ore 9 tons of precipitate were produced averaging 72.22% copper. The ore from the Moonta mines averaged 10.94% of copper and in addition to the ore 507 tons of precipitates were produced which averaged 74.29% copper. The production from purchased ores amounted to 291 tons of fine copper. The balance of liquid assets was $724,723 over current liabilities.

It is stated that the great success of ore-dressing through the use of the flotation process at the Wallaroo mines has led to the adoption of the process at the Moonta property. So far as this treatment has progressed there is every evidence that it will materially assist in working low-grade ores at a profit that otherwise would be rejected. The installation of the flotation plant at the Wallaroo mines has called for the exercise of considerable care and skill and has also involved a good deal of expenditure. The plant consists of tube mills and other recrushing machinery, elevating and settling appliances and the flotation machinery.

The Government's Attitude Toward the American Smelting & Refining Co.

Washington Correspondence

Attorney-General McReynolds is still carrying on investigations into the organization of the American Smelting & Refining Co., with a view to making a definite report as to whether the concern is or is not a "trust," and as such needs to be prosecuted under the law as now framed. By inquiry at the Department, it is learned that the Attorney-General will not make any definite report either to Congress or to the President for some little time to come with reference to this subject. He has, however, completed the so called "field work," and whatever remains to be done is in the nature of office investigation, consultation with the company and decision on the line of policy to be followed. It is intimated at the department that the ultimate outcome will depend a good deal upon the attitude taken by the company itself in conferences which are now understood to be in progress between representatives of the department and of the concern itself. Included in the subject matter of the discussion, it is understood, is some consideration of the labor situation in the plants of the corporation, a phase of the concern's work which has recently been brought under the general consideration of former Commissioner of Labor Charles P. Neill, who has been transferred to the New York office of the company. If the corporation should be inclined to follow the suggestions of the Gov-

ernment, it is believed that it will be treated as was the New Haven, that is to say, nothing will be done to interfere with it through court proceedings. Government officials refuse to go into detail as to the points that are now at issue, but it is understood that they have been informed that any change in the form of organization of the company would be exceedingly difficult, inasmuch as the separation of the ownership of the various plants would hardly be feasible. The process of smelting is carried on successfully and profitably because of the cooperation of the different plants in dealing with the different grades of ore and in adjusting their production to the requirements of the different qualities of ore purchased in the various parts of the country. It is claimed that there is no "trust" in the ordinary sense of the word, inasmuch as the concern is subject to competition of a sharp kind from many sources.

Apparently the hostility to the Smelting & Refining Co. in Congress which was very acute about a year and a half ago, at the time when Attorney-General Wickersham announced that there was no trust in the business, has fallen off somewhat, partly on account of the fact that the Department of Justice is continuing its inquiries, under the new management of Mr. McReynolds, partly because some of the foremost opponents of the concern have left Congress.

The Department is working on the affairs of the so called quicksilver pool and authorized representatives state that as in the case of the smelting question, the field work has been done, but that no report in this matter will be formally made for some time to come. Quiet investigations are being made into the copper situation and particularly in the labor conditions in the copper industry, but no action as to these is in prospect for the immediate future.

Well informed persons assert that the administration has no wish in the present condition of the markets to introduce additional difficulties or to attempt proceedings that would unnecessarily harass any concern. In fact, such statements have been made of late in a semi-official way. The opinion is further expressed that nothing definite is likely to be done until the administration's anti-trust program has taken form and that when it has thus taken shape, the existing concerns will be asked to conform to it as nearly as they reasonably can. This plan, if followed, will defer matters for some time.

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Bureau of Mines Appropriations

The estimates of appropriations for the United States Bureau of Mines, for the fiscal year ended June 30, 1915, as approved by the Secretary of the Interior, have just been forwarded to Congress. The estimates are as follows:

For general expenses of the Bureau of Mines, $70,000; investigating mine accidents, $347,000; equipment of mine rescue cars and stations, $30,000; equipment of testing plant at Pittsburgh, Penn., $10,000; testing fuels, $135,000; mineral-mining investigations, $120,000.

For inquiries and investigations of petroleum and natural gas, $30,000; inspection of mines in Alaska, $7000; books and publications, $2000; lands, leases, etc., for mine rescue cars, $1000. The total for the Bureau of Mines is $752,000. The item of $30,000 for the equipment of rescue cars and stations is for the first time placed separately in the estimates and represents an increase.

The $10,000 asked for the equipment of the testing plant is needed for the purchase of steam and electric equipment. The estimates set forth that the present power and electric service plant at the experiment station is on the eve of breakdown. For the mineral-mining investigations, an increase of $20,000 is asked, from $100,000 to $120,000. For the inspection of mines in Alaska, an increase of $500 over the previous year is asked. The same increase is asked for books and publications. The item for lands, leases, etc., for mine rescue cars is decreased $1000.

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Coal and Iron in Manchuria

A report from Consul General F. D. Fisher, at Mukden, Manchuria, says that the capitalization of the Pen Hsi Hu Colliery & Mining Co. has been increased to 5,000,000 yen (about $2,500,000), of which 2,000,000 yen is to be applied to the working of the colliery and 3,000,000 yen to the exploitation of the iron-ore deposits. Of the latter sum, 500,000 yen is now being expended in the installation of a blast furnace to have a capacity of 100 tons of pig iron per day, which will be followed later by the construction of three other blast furnaces of equal capacity, together with a complete steel plant.

The ore beds are in strata lying parallel with the slope of the mountain, and while development work has not been completed, an estimate places the amount of ore practically in sight at 80,000,000 tons, with a probability that the amount is larger. The ore is magnetite, portions of which run as high as 70% iron, and may be easily worked. The lower grades, however, will probably require magnetic separation.

From the development work in only a portion of the coal fields it is estimated that 120,000,000 tons are in sight. The coal is semi-anthracite, containing little sulphur, and is of excellent coking quality. It is reported that, owing to the favorable position of the ore beds, the ore can be mined and brought to the station of Nan Fen, six miles distant, where the smelters are to be located, for about $1.20 per ton.

While conservative engineers may consider that the superficial development work actually done does not fully warrant the assumption that the estimated amount of ore is actually there, such assumption may be based upon fair probability, and, if further work proves it to be correct, this undertaking will no doubt develop into extensive proportions. It is now looked upon as solving the present problem confronting the different steel works in Japan, that of getting pig iron.

As Okura & Co., which represents the Japanese interests in this concern and has the practical management of it, represents various German machinery houses, it is probable that German machinery will almost wholly be used in the works. Two German boilers of 12,000 hp. have already been received.

A Geological Drainage Problem

By R. R. Heap*

SYNOPSIS—It was long held impossible to lower the water level in the Miami district sufficiently to permit mining the lower Boone chert ore-runs. Previous pumping more or less unsuccessful. The Lennan Zinc & Lead Co. took advantage of the impervious Cherokee shale alongside steeply dipping ore to get a dry shaft to considerable depth. Drill holes and centrifugal pumps used to drain lower ore run. A stimulus to mining in the district. Coöperation on the part of other operators.

The Miami district, as it is commonly known, is one of the groups of mines that, linked together, form the Southwestern zinc and lead field. It is located in Ottawa County, Okla., four miles north of Miami, the county seat, from which it derives its name and about four miles south of the Kansas line. Its position with reference to the field at large, is on the extreme southwestern edge (Fig. 1.) The nearest district of importance is that of Galena, Kan., 20 miles northeast of Joplin, the commercial center of the district, being distant eight miles to the east of Galena.

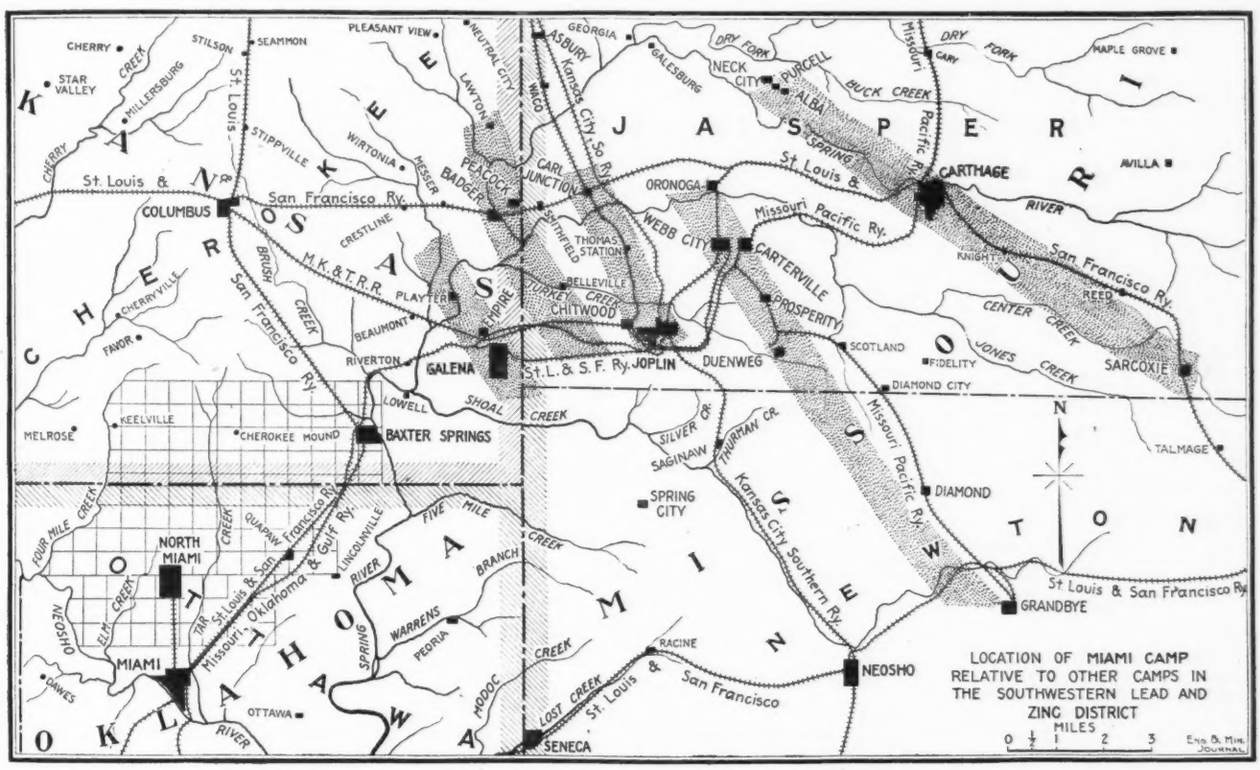

Fig. 1. The Southwestern Lead and Zinc District

History of Early Pumping and Ore Development

The initial development work in this district was carried on during the fall of 1907 in the southern part, on the shallower upper levels of the New State mine, operated at that time by the Standefer brothers, the pioneer miners of the district. The water, which at that time was considered to be an artesian flow, stood at a level of 34 ft. from the surface and it required two 14-in. cornish pumps running continuously day and night for a period of 84 days to lower the water table to the 102-ft. level, where mining operations were commenced.

It was at this early stage of mining that conjectures were made regarding the pumping problem as shown by the following paragraph from one of the government geologists' report:

> A circumstance which has delayed the development of the district is that each undertaking requires the raising of 500 to 750 gal. of water per min. This, of course, has been the case in most of the new camps in the Joplin region. With the lowering of the underground water level to the level of mining, the amount of pumping ordinarly becomes inconsiderable. In the Miami district, however, the situation is somewhat exceptional. The surface of the ground is low, not more than 25 ft. above Tar Creek, the drainage level for the region, and the water-bearing ore stratum is capped by the unbroken Cherokee shale. The mine water is different from the surface water in other camps, being highly charged with H_2S, like the deeper artesian waters, and the height to which it rises may represent artesian head rather than the underground water table. If this be so, there may be no great diminution of the amount of water with time, but on the contrary a possible increase with the development of the underground workings.

Later, in 1908, C. W. Reed, of the Queen City-Joplin, lowered the underground water level to 126 ft., and with no financial assistance from the other operators, assumed the entire burden of pumping for about a year; this per-

*Superintendent, Lennan Zinc & Lead Co. and Miami Zinc & Lead Co., Miami, Okla.

mitted of dry mining to approximately that level in all of the area developed at the time, the flow of water at the new level approximating 500 gal. per minute.

Development work was gradually being carried on to the north, and when C. W. Reed shut down in 1909 the Standefer brothers, who were then mining on the S E 40 of the Emma Gordon 200-acre tract, again assumed the greater pumping burden, and with some assistance from the operators were able to sink their north shaft, at that time the most northerly of any operating shaft, to the 163-ft. level. It required a 6-in. steam pump running at full capacity to hold the water at that level, which, with the small amount of pumping done by others, would probably have shown a flow of about 750 gal. per min. at that level of mining.

Geology of District

Up to this time no serious attention had been given by any of the operators to the general geology, especially to the unbroken, dry and impervious Cherokee shale, which caps the upper runs in the Chester sandstone. It was an established fact, however, as shown by actual development and drill exploration, that there was a pitch to the ore runs in a general northerly direction, from which it was concluded that any operations carried on north of the S E Gordon 40 would necessitate deeper mining and pumping operations of greater magnitude. Victor Rakowsky, of Duluth, in a careful and extensive examination, has given us a more comprehensive insight into the general geology as applied to mining than any engineer of note who has yet visited the district and to him I am indebted for most of the following geological data.

The orebodies occur in regular and well defined deposits of brecciated sandstone and flint, cemented usually with jasperoid, sphalerite and galena, and carrying sphalerite, galena and iron sulphide. The Chester sandstone contains the upper, and the Boone chert, the lower, orebodies. Referring to Fig. 2, it will be noted that there are two definite subzones of mineralization which diverge at an angle of 56° striking N 22° W and N 34° E. The former zone is developed more extensively than the latter, and is made up of a system of parallel runs, while but a single run has been developed with the northeast strike. Outside drilling, however, points to other parallel runs in this direction. Two layers of ore are mined on each of the runs shown, the upper in the sandstone and the lower in the chert.

As in the general Joplin area, the rocks in the Miami district seem to comprise the Boone, Chester and Cherokee formations in ascending order, these formations being unconformable. There is apparently a solution unconformity existing between the Boone and the Chester at points where there is a steep dip in the upper sandstone and consequently in the orebodies therein, this steep portion extending some distance along the strike. The only point where these steeply inclined orebodies have been developed by mining operations is on the properties of Lennan & Co., where the central pumping plant is located. The Cherokee shale here lying unconformably on the sandstone fills the erosion valley to a maximum depth of 310 ft. as proved by drill holes. The occurrence of the shale at this depth permitted lowering the water to the mining level by a single method.

The Orebodies

The ore occurs in zonal breccias and takes the form of regular, elongated bodies. The usual dislocation, slickensiding and moderate faulting is apparently due to minor displacement and underground solution. Distinct and defined runs in the Joplin district are rare, on account of the general displacement of the orebearing area. In the Miami district, however, the mineralization occurs along absolutely defined lines in simple uniform runs, the

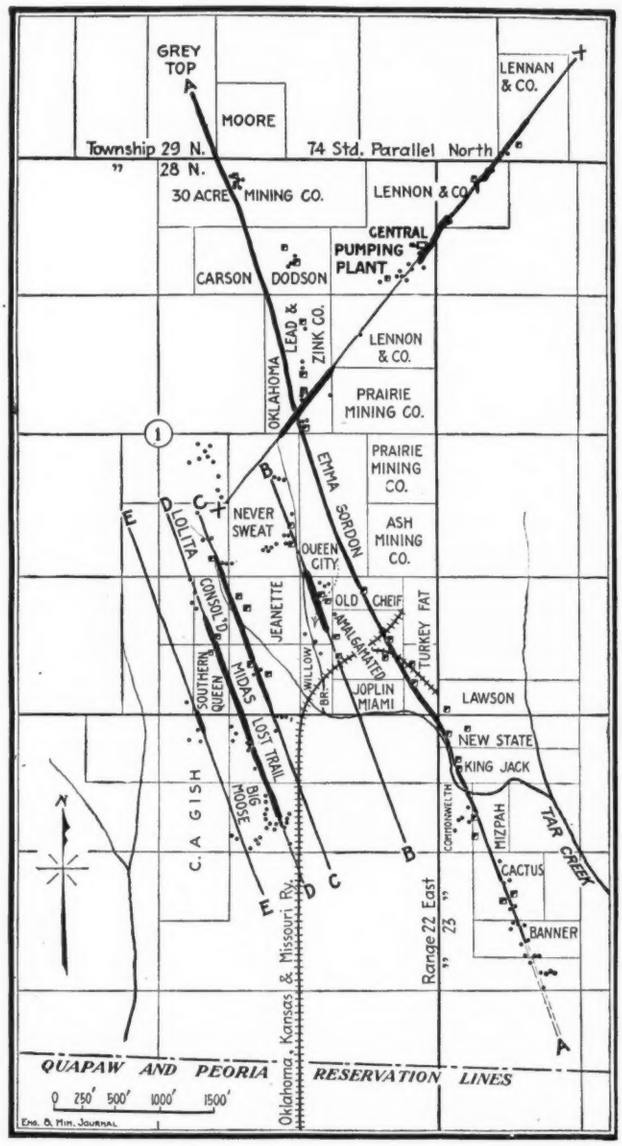

Fig. 2. Zones of Mineralization, Southwestern Lead-Zinc District

complicated and compound Joplin runs being entirely absent or not yet found. The linear extent of the runs is great, the *A* run, Fig. 2, being developed and defined for a distance of 9000 feet.

Mineralization occurs in the zonal breccia contiguous to the fractures. These fractures, cutting all the formations, probably occurred at the time of mineralization or prior thereto and may have resulted from a warping of the beds. There is often a sheeted flint developed with the fractures and this flint usually is not mineral-

ized. Apparently the mineralization and the galena content are greater in the less broken ground contiguous to the fractures.

Referring to Fig. 4, it is assumed that the development of the erosion valley was prior to the mineralization, and that the subsequent fracturing and mineralization occurred at the edge of the erosion valley at this point. On all of the runs below the point of intersection of the *X* run and the *A* run, Fig. 2, the formations are approximately flat lying. Along the *A* run northwest of the point of intersection with the *X* run, the dip of the ore is in a northeasterly direction. These orebodies would then lie on the westerly limb of the syncline. Fig. 4 shows the ore in the sandstone with a steep dip to the northwest, the relation existing between this upper ore and the lower ore in the flint and the position of the Cherokee shale. It

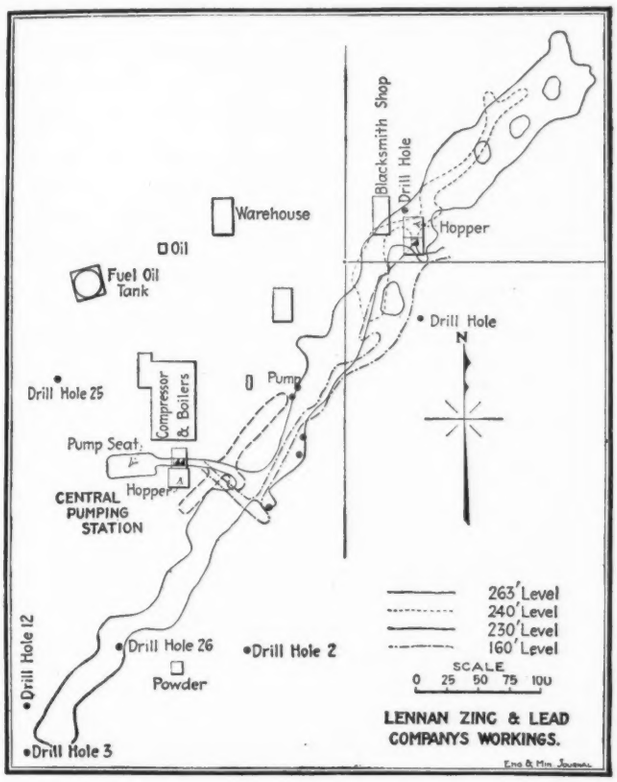

FIG. 3. MAP OF THE LENNAN WORKINGS

is believed that the lower flint orebody will be found to lie approximately flat, the mineralization extending, of course, only as far as the brecciation.

FIRST HEAVY PUMPING OPERATIONS

Knowing that a heavier flow of water would be encountered at a deeper level of mining, L. C. Church, of the Church-Mabon properties, which are situated on an adjoining 40 northwest of the SE Gordon 40, Fig. 2, after a considerable amount of drilling, commenced early in 1910 the sinking of two shafts with the view of lowering the water table to at least the 220-ft. level; this would permit extensive mining of his properties on the *A* run in the Chester sandstone formation. He was the first operator to give any serious consideration to the Cherokee shale as an important factor in the pumping problem, and he sank his north shaft through this dry and impervious shale to what at that time he considered its greatest depth, 240 ft. A pump compartment was cut at the 230-ft. point and a drift cut through the shale to tap the water and the ore. The first installation consisted of two 7-in. compound steam pumps, which, unfortunately, proved inadequate for continuous service.

The other shaft located almost 1000 ft. south, encountered the rock and water at 196 ft. In this shaft was installed a double, 6-in. discharge, vertical-shaft drive, six-stage centrifugal pump, the shafting being held in place between the two 6-in. discharge columns by adjustable boxes clamped to the columns; it was belt driven by a gas engine on the surface. This pump had a rated capacity of 1250 gal. per min. against a 250-ft. head. Later, to uncover the submerged steam pipes, a similar installation was made in the north shaft.

Considerable trouble was experienced in these pumping operations, which did not permit an uninterrupted lowering of the water level. In sinking the south shaft, the

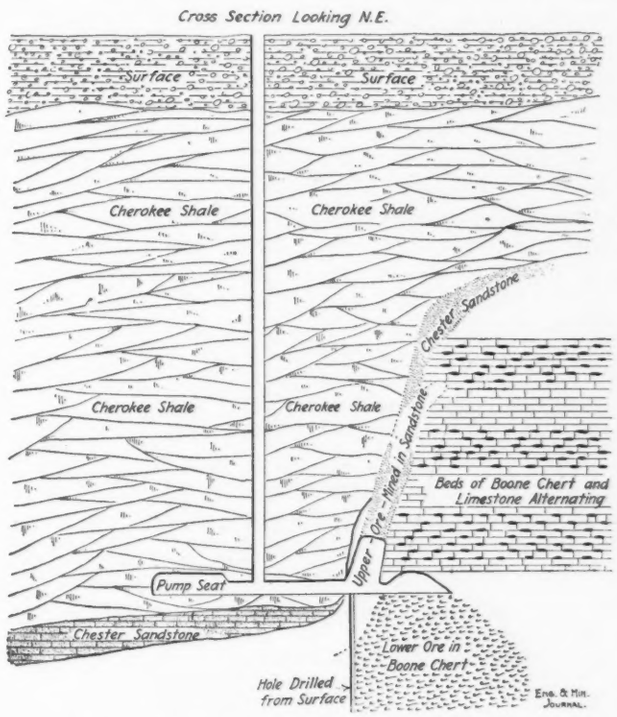

FIG. 4. STRATIFICATION IN MIAMI DISTRICT

blasting necessitated disconnecting and raising the pump, with ensuing delays. The long, small-diameter, driving shaft was also a source of trouble, and the volume pumped in the north shaft was not in sufficient excess of the normal inflow to rapidly lower the water level. Pumping operations were commenced Nov. 4, 1910. The south shaft was sunk to a depth of 236 ft., and the water was under sufficient control to permit of mining at the 230-ft. level in the north shaft and at the 220-ft. level in the south shaft in September, 1911. By weir measurement, the flow of water was 1000 gal. per minute.

PUMPING METHOD BASED ON GEOLOGICAL CONSIDERATIONS

Meanwhile, much drilling had been done farther north on the northeast 40 of the Gordon tract and on the adjoining north 10 acres east, one mile due north from the New State mine. It was on these properties that the

northeast or *X* run was discovered, showing ore at the deepest level of mining contemplated in the Southwestern Field. The drill explorations, of interest from both a geological and mining standpoint, showed the deepest deposition of shale and occurrence of ore and a dissimilarity between this northeast run and the northwest runs; of the latter, the *A* run is the best defined, showing a distinctly steeper inclination of the shale contiguous to the ore of the Chester sandstone and a decidedly marked dip of the run to the northwest. At a distance of 400 ft. northwest of the *X* run the shale was found deposited to a depth of 310 ft. Drilling showed the occurrence of ore almost without variation to a depth of 320 ft., the thickness being dependent on the location of the hole with respect to the inclination of the formation; the farther southeast, within the boundaries of the run, the shallower the upper ore and the greater the thickness of the lower ore, as can readily be seen from Fig. 4. The depth of the shale was variable, depending on the distance of the hole from the contact.

In planning the operations, a prime consideration was the situation of the pump shaft, to determine which the following factors were considered: The depth of the shale, its depth as related to ore levels, its inclination, the proximity of the ore run, the tramming distance, the necessity of both a pumping and a hoisting compartment and the method of timbering. The greatest depth to which the shale reached, 310 ft., was at a point some distance from the ore, and it also would not admit of sinking a dry shaft to the bottom of the ore; hence it was evident that to reach this bottom, two stages of pumping operations would be necessary. The first stage could be accomplished by sinking a dry shaft in the shale at the point which would give the greatest gain in depth and the least loss in its distance from the ore. The steep inclination of the contact continued to a depth of 270 ft., and below that depth showed a decided flattening, so that any further gain in shaft depth would be at a decided sacrifice in distance from the ore, in the ratio of 15:100. It was, therefore, decided to sink the shaft at a point 60 ft. from the ore.

The Shaft and Pump Station

Experience in this district has shown that for hoisting with cans, from 28 in. to 30 in. in diameter, a shaft 5 ft. or 5½ ft. square is large enough, and it was, therefore, decided to make the size of the shaft 5½x11½ ft. in the clear, allowing 6 in. for a solid center brace of 4x6-in. pine. The common district method of shaft cribbing with 2x6-in. lumber was used; this will stand without distortion for a number of years. The shaft encountered the rock and water at 273 ft. Two feet below the bottom of the sump the holes which tapped the water were carefully plugged and the cutting of the pump compartment was started at the 263-ft. level. It was known that the flow of water at the 220-ft. level was 1000 gal. per min., and that the water in the tram shaft 250 ft. northeast of the pump shaft was standing at the 210-ft. level, showing a drainage head of over 50 ft. It was reasonable to expect an increase in the inflow with an increase in depth; this led to an estimate of a normal inflow of 1500 gal. per min. at 263 ft. Any rapid lowering of the water level would require the raising of a considerable amount in excess of this estimated inflow, taking into consideration the drainage head and the extent of the drainage area. It was, therefore, decided to install a pump rated at 3000 gal. per min. against a head of at least 300 ft., and the pump chosen was a duplex, triple-expansion, 16x24-in. corliss type, condensing Prescott, with a 16-in. suction and 14-in. discharge, rated to deliver 3000 gal. per min. to a height of 350 feet.

The pump compartment was cut on the west side of the shaft, of a size to give ample room, being 50 ft. in length by 16 ft. in width and 14 ft. in height. Steel sets were used, placed 6 ft. apart, the sides tightly lagged with 2-in. planks, well filled in behind, and the caps with 6x6-in. caps tightly floored with 2-in. planks. The water drift, which was subsequently to be the tram drift, was cut from the east side of the shaft, being made 10 ft. high at the shaft and lowered to 7 ft. two sets back; it was 7 ft. wide, the sets of square 8x8-in. posts and caps being placed 4 ft. apart and tightly lagged side and top with 2x12-in. planks.

Methods of Water-Flow Control

At a distance of 22 ft. from the shaft, a heavy steel hinged door and frame were installed, and a tight concrete joint to the timber was made. The door was held tightly closed against the frame with a 1⅛-in. turnbuckle rod. In the door were three valves, and at the bottom, a slide gate. By means of these valves and the gate, the volume of water flowing to the pump could be accurately regulated during the preliminary drainage period. Beyond the door, a small sump was cut in the shale to settle as much sand as possible before reaching the shaft sump.

As soon as the pump installation was completed the drift was cut to the rock and the water tapped with a roof hole of the first round in the rock. Due to the 50 ft. head of water, only a few holes shot in the face were necessary at first to give the pump 2000 gal. of water per min. After shooting, the door was closed and a volume of 2000 gal. per min. allowed to flow the pump. A few weeks of pumping showed a rapid lowering of the water table and demonstrated the success of the method. The valves were then closed and the pump shut down, the small leakage around the door being easily handled with a 3-in. pump. The entire coöperation of the operators in the district was secured and the pumping contracts signed, after which the valves were opened and pumping commenced in earnest in September, 1912.

Drifting and Mining

With any diminution in the flow of water, more holes were drilled in the face, and a hole at a time was shot. The pump worked almost steadily on a volume of 2000 gal. per min. for a period of 50 days, when the water level had been lowered sufficiently to permit of crosscutting the run. This progressed slowly because of the necessity of closing the door after each round of shots and then waiting for the water to drain below the top valve before opening the lower slide gate which would let the water drain down sufficiently to swing the door back into the drift safely. The water pouring in from all sides let the H_2S escape, which made it necessary at first to work a double crew half an hour on and off, without even then obtaining good results. These difficulties made the development work progress slowly, and almost

two months were required for drifting sufficiently to permit mining a reasonable tonnage.

The first diminution in the inflow was noticeable when the water table receded below the top of the drift door, from which the time the decrease continued at the rate of about 100 gal. per week until no seepage through the breccia cementations in the face was noticeable. Since this time, with the face of the drift down dry to the floor, the inflow has remained seemingly constant, being between 1200 and 1250 gal. per min. The total amount of time consumed in the lowering of the water table from the 210-ft. level to the 263-ft., was five months.

Mining operations in the drift were commenced in February, 1913, the heading-and-stope method so common in this district being used. The best results in the heading were obtained with a five-hole round composed of one lead-breast, one front cut, one roof, one back cut and one lifter, the lifter being drilled directly below the roof between the two cuts; the holes were shot in the order named. Because of the proximity of the confining wall of shale and the formation of the roof, 12-ft. holes in the stope were the longest it was safe to drill and shoot.

Second Stage in Draining

Knowing that most of the ore lay below the 163-ft. level on all of these properties, steps were at once taken to formulate the best method for lowering the water down to 320 ft. The porosity of the formation and the drainage connection of the system of runs was well established by evident facts. At a distance of 3½ miles northeast along the strike line of the *X* run, a 3-in. pump handled the water at the 200-ft. level. One mile south on the *A* run at a point 20 ft. lower, the water level was at 212 ft., at which level the lower run in the Boone chert formation was being worked. The brecciation of the flint was strongly marked within the limits of this ore run.

To attempt to sink the pump shaft itself was inadvisable, since by tapping the water in the shaft, the door protection in the drift would be destroyed and the northeast tram shaft, which was connected to the pump shaft by a drift the full width of the upper run, was necessary for the current mining operations. To sink in either of the two unconnected shafts meant raising the water to the surface, which eliminated their use. These facts showed that any sinking must be done at some point or points in the drift in the ore run behind the door.

Drill-Hole Pumping

The drainage of a shaft by means of a drill hole was known to be possible where the volume of water to be raised was not considerable. The question was whether this method of drainage could be put into successful application where the amount of water was large. If so, a drill hole of sufficiently large diameter for a 9-in. or 10-in. suction pipe could be put down below the 263-ft. level and by the installation of a centrifugal pump the water level lowered an amount equal to the maximum suction lift of the pump. The only objection to this method was the question whether the size of the hole would permit an overflow of water sufficiently in excess of the normal inflow to afford rapid drainage.

The formation, due to the sandstone and flint breccia, was such that by a sufficient amount of shooting a chamber of considerable size could be made at any desired depth in the hole, large enough, we believe, to furnish a volume of 2000 gal. per min. to the pump suction. In this event, the porosity of the formation would allow the water table to be easily lowered. A place in the drift was, therefore, selected as most suitable for the hole from all points of view, and the point was also located on the surface with a transit. A 6¼-in. hole was put down from the surface, passing through the drift at 239 ft. Below the drift it was in rich ore from the 262-ft. point to the 320-ft., the bottom of the run. The drilling below the drift was watched carefully; between 20 ft. and 25 ft. the hole was in decidedly open ground from which no cuttings were raised; at 33 ft. it passed through the sandstone into the chert in which it continued in good ore for 26 ft. The sand pump seldom raised the full amount of cuttings to be properly expected, which further established the porosity of the formation.

The hole was then reamed out for the entire distance below the floor of the drift with a 15-in. bit, which, due to its weight of 1400 lb., must have made a 16-in. to 18-in. hole. At the bottom of the hole, 60 ft. below the floor of the drift, two charges of 40% dynamite were shot, using 35 and 57 sticks, respectively, for the first and second shooting. The big bit was then lowered into the hole, which had been thoroughly cleaned out before the shooting, and the rock chopped up, after which the hole was again cleaned out, the amount of cuttings raised showing that a chamber of considerable size had been made. Two similar chambers were made at points between 40 and 45 ft., and between 20 and 25 ft. below the drift. It took six days to mash up and pump out the rock broken by the shooting of these three different places in the hole. Data from the American Well Works gave a suction lift of 25 ft. for their pumps. Hence we chambered the hole in 20-ft. stages in order that a 25-ft. suction, deducting 2 ft. for the distance between the top of the suction and the floor of the drift, would put the bottom of the suction in about the largest part of the chamber in the hole, as shown in Fig. 5.

Centrifugal Pump Installed

The first test was made with a 6-in., common type, centrifugal pump with an 8-in. suction. The pump and a 16-hp. steam engine, we happened to have on hand, were bolted to a solidly built frame of 8x8-in. timbers which was set level on the hard rock floor and filled with a 1:3 mixture of cement and tailing in all its open spaces. The length of the frame was 20 ft., and the distance between pump and engine centers 16 ft. As a precaution, the top 12 ft. of the hole was cased with 12-in. pipe perforated with 1-in. holes. No foot valve was used, but an 8-in. check valve was screwed to the top of the 23-ft. length of suction pipe in the hole, the bottom of the valve resting on the 12-in. casing. A short nipple was screwed into the valve, then a T and into this a 3-ft. horizontal nipple for connecting the pump suction to the bowl. The T permitted the use of a 4-ft. standpipe closed with an 8-in. cap. To eliminate all possible discharge head, the bowl was turned one-quarter around the horizontal axis, placing the discharge flange in a vertical position. A launder 12 in. wide by 10 in. high was built to carry the water from the pump as far as the sump in the shale behind the door, whence it would flow to the Prescott. The drill hole to the surface was cased off with 5⅝-in. casing for the depth of the shale, 170 ft.

The steam was carried down this hole with a 3-in. line reduced to 2 in. in the drift near the engine, the 3-in. line being used in order to have ample capacity for a second pump and hoist later on.

When the pump started, the water stood at the top of the hole, occasionally welling over. The pump was gradually speeded up to 730 r.p.m., which was the maximum attainable with the 16-hp. engine. At this speed, it discharged a volume of 1500 gal. per min. The water was lowered quickly in the hole to a depth of 17 ft.; under this increased lift, the engine was capable of maintaining a pump speed of only 620 r.p.m., and a 12x14-in. engine was, therefore, installed. The pump was given a speed of 900 r.p.m., discharging at first over 1600 gal. of water per min. The volume decreased as the suction lift increased, and at present with a lift of over 20 ft., the pump is discharging 1350 gal. per minute.

The level of the water table was quickly lowered in a small area near the hole, but required four days of pumping to be noticeable at any appreciable distance, when at a distance of 250 ft. south of the pump hole the water was found to be lowered in an open drill hole to a point 4 ft. below the floor of the drift. Since then the water is being lowered in this hole at the rate of about 3 in. in 24 hr., the level of the water after 14 days of pumping being 7 ft. 6 in. below the floor of the drift. In the northwest mill shaft, 700 ft. distant from the pump hole, one 3-in. pump is now easily handling the water at the 260-ft. level, which required the use of two 3-in. pumps running to capacity two weeks ago.

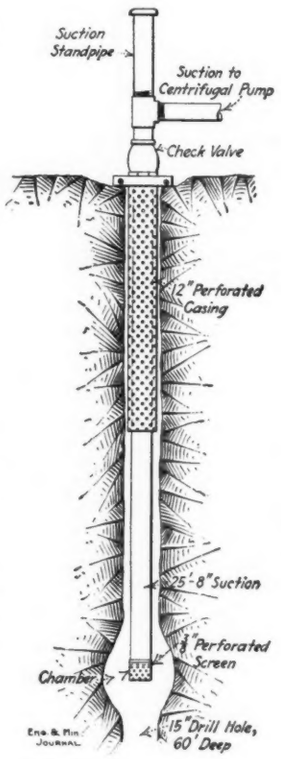

FIG. 5. PUMP-SUCTION SETTING

SECOND HOLE UNDER WAY

A second pump hole in a similar place in the drift, but 25 ft. north of the adjacent northeast tram shaft and 180 ft. northeast of the first hole will be completed in a short time. The installation in this hole will consist of an 8-in. common type centrifugal pump rated at from 1800 to 2200 gal. per min., and instead of a check valve a specially designed 9-in. foot valve will be used, measuring 12 in. in extreme diameter with a 9-in. saucer valve working on a vertical stem, so as to give a 2-in. clearance lift between the valve and seat. A launder will be run from this pump to discharge into the launder of the 6-in. pump.

Upon the completion of the installation of this 8-in. pump, both pumps will be run at a moderate speed, sufficient to discharge a total volume of over 2000 gal. per min. to the Prescott. It may be deemed advisable to install another 8-in. pump in the place of the 6-in. to insure a discharge volume of 2000 gal., with only one pump in operation.

Continuous pumping of 2000 gal. per min. will soon lower the level of the water table, at least locally, to the depth of the suction lift, between 20 ft. and 22 ft. below the present level. This will be the first of the three levels necessary for lowering the water to the 320-ft. mining level.

PROBABLE FUTURE OPERATIONS

On starting the second pump, a winze at the nearest safe distance from each hole will be sunk to a depth of 20 ft. and a small drift cut to each pump hole. The method of procedure then is not definite, but will be more easily worked out at that time.

A third pump, connected by gears or flexible-shaft drive to a vertical engine on the same stand, may be installed at the entry of the winze with the suction in the winze sump; this sump could easily be shot and cleaned out to a depth of 3 ft. below the water level. The discharge could be run up the winze into the launder above. By virtue of the heavy shooting in chambering the hole the ground would be shattered enough to be able to pick into the pump hole, and after raising the suction the drill hole could be plugged and the hole enlarged. Then by means of falls above and clamps below the suction could be lowered to the requisite depth below this 280-ft. level, the pump and engine lowered and installed with the discharge pipe in the hole and a similar procedure worked out at the south hole after the north pump in its new position had been run long enough to keep the south hole drained below the 280-ft. level. Then with both pumps on the 280-ft. level, the water level could be soon lowered to the 300-ft. level, to be followed by a repetition of the procedure and final lowering of the water to the 320-ft. level, at which level a pump will be installed at the northeast tram shaft of sufficient capacity to raise the volume of water directly to the surface. It would not be unreasonable to estimate a lowering of the water level at the rate of 1 ft. per day. The cost of drilling and completing the two holes, of one 6-in. and two 8-in. pumps, of two 12x14-in. engines, of all of the pipes and fittings, inclusive of those for the suctions and of the labor of installation will not quite reach $2100. No fair estimate can be made at this time of the total cost of reaching the 320-ft. level, but it is safe to say it will be far below that entailed by attempting to sink a shaft in the water either by staging with pump seats or by means of a sinking pump of large capacity.

NECESSITY OF COÖPERATION

It will be seen from the foregoing paragraphs that the mining conditions in this direction are unique, being dissimilar, with respect to mine drainage, from any of the other districts in the Southwestern field. These peculiar drainage conditions put upon the particular company mining at the lowest level the entire burden of pumping for the district, the water in the entire system of runs falling to a surprisingly close level according to the distance from the pumping shaft.

This would seem highly unfair to the company doing the pumping, were it not for the fact that this water is an absolute necessity for the milling of the ore. For this purpose and also in recognition of the benefits derived in the complete drainage of the different mines, each operating company pays a weekly rental for the use of water in its mill, and each development company, after striking the ore run, pays a one-half rental during its develop-

ment period up to the starting of its mill. The relationship between the company operating the central pumping plant and all of the other operators has resulted in the development of a weekly pumping charge agreeable to all concerned and has brought out a community interest in this district, which does not exist elsewhere in the Southwestern zinc and lead field.

Future of the District

The method of installation, the size of the pump, and the ease with which the water has been handled, give the district the assurance of a continuous maintenance of the water level at a depth sufficient to permit uninterrupted dry mining in the lower Boone chert ore-runs. The water problem in this district was the most serious obstacle in mining the lower runs. These have proved to be extremely profitable. Therefore, the rapid drainage of the entire system of ore runs has resulted in a steadily increasing production on the part of the operating companies and has indirectly increased the amount of exploration work. A small increase in production, now assured by the development of numerous new properties, will soon give this district third place in the entire Southwestern field, in value of product.

The two different methods of solving the pumping problem, first, in lowering the water table to the 263-ft. level, and second, in lowering it to the 320-ft. level are extremely simple solutions of rather difficult problems, which are, however, not of unusual occurrence in this field at least. The first method of procedure shows the importance of using the shale deposit capping the ore as providing a means of dry sinking, of installing pumps of more than adequate capacity and of using steel-door protection and valve regulation. The second method shows the importance of the porosity of the formation as a means of drainage by drill holes of large diameter.

Drainage by drill holes has the following distinct advantages: The pumping of absolutely clear water, the rapid depression of the water level below the present one, dry and inexpensive sinking and cheapness of installation.

Aluminum Production in Norway

The production of aluminum appears to be making rapid headway in Norway, says the *Mining Journal,* Nov. 1, 1913. The Anglo-Norwegian Aluminum Co. has already successfully established its works at Vennesla, near Christianssand, with an annual capacity of about 2000 tons of 99 to 99½% aluminum. The company manufactures its own electrodes on the premises. The works of the Hardanger Electrical Iron & Steel Co. has been taken over by a syndicate or company, mainly French, for the manufacture of aluminum cables. The new company will adapt and add to the present buildings for the installment of its machinery, taking its power from the Tysse falls.

The Norske Nitridaktieselskap (capitalized at 10,000,000 kroner) has now almost completed its large works at Eydehavn, near Arendal. The quays are finished, the workmen's dwellings roofed, and the main factories are well forward. Swiftly as the work has been pushed, it has not kept pace with developments in the manufacture of the product. The new method for the fixation of atmospheric nitrite (which it was the original intention to operate on a large scale) has reached a new phase. A new furnace type has been constructed, which has considerable advantages over the former one, and this again has encouraged the company to improve still further the French method before it proceeds to extensive manufacture.

In order, therefore, to fill up the necessary waiting period, the company has decided to adapt its present works for the production of aluminum. The choice has been induced by the fact that some aluminum patent rights are held by the financial interests connected with the Norske Nitridaktieselskap. The bauxite will be imported from France. The excellent harbor conditions and the easy means of getting electric power from the regulated Arendal catchment should render the Eydehavn works well adapted for the production of aluminum. It is expected that manufacturing will have begun early next year. When in full working 25,000 hp. will be available, and about 400 hands employed.

Italian Iron and Steel Production

The completed statistics of the production of iron and steel in Italy, and also those of coal, for 1912, have been made public. Italy is a small producer of coal and iron ore, and much of its metallurgical industry depends on imported raw materials.

Iron Ore

The production of iron ore in 1912, was 582,066 tons, which compares with 373,786 tons in 1911 and 551,259 tons in 1910. Imports of iron ore in 1912 were 18,551 tons and exports were 12,313 tons. The production of manganese ore was 2641 tons. There was also produced 248,612 tons of iron pyrites, of which only 2144 tons were exported, while 70,762 tons were imported.

Pig Iron and Steel

The make of pig iron and direct castings in 1912 was 418,675 metric tons, which compares with 342,586 tons in 1911. The make of steel ingots, largely from imported pig and scrap, was 922,000 tons, a gain of 186,000 tons over 1911.

The make of wrought iron from pig was only 1500 tons, but there was a large quantity made from scrap, some of it imported material.

Finished Materials

The total production of finished material was as follows, in metric tons:

	1912	1913	Changes
Wrought iron	303,223	179,516	D. 123,707
Steel	697,958	801,907	I. 103,949
Total	1,001,181	981,423	D. 20,242

The principal items of finished steel in 1912 were 392,263 tons of bars and shapes, 130,067 tons rails and 89,905 tons of plates and sheets. The output of tin plates was 28,916 tons.

In 1912, there were in operation in Italy, 64 open-hearth furnaces, two bessemer converters, two Robert converters, five electric furnaces and two crucible furnaces.

The production of coal in Italy in 1912 was 663,812 metric tons, of which 660,491 tons are classed as lignite. Imports were 10,057,228 tons; exports 26,288 tons. The coke made—largely from imported coal—was 1,223,902 tons; briquettes, 874,365 tons.

Depreciation to Be Deducted from Mining Company Profits

WASHINGTON CORRESPONDENCE

After ten days' delay since the official announcement of the opinion, Justice Pitney has completed his revision of the text of the decision in the case involving the application of the corporation tax to mining properties, brought by Stratton's Independence, Ltd. The decision says:

The peculiar character of mining property is sufficiently obvious. Prior to development it may present to the naked eye a mere tract of land with barren surface, and of no practical value except for what may be found beneath. Then follow excavation, discovery, development, extraction of ores, resulting eventually, if the process be thorough, in the complete exhaustion of the mineral contents so far as they are worth removing. Theoretically, and according to the argument, the entire value of the mine, as ultimately developed, existed from the beginning. Practically, however, and from the commercial standpoint, the value, that is, the exchangeable or market value, depends upon different considerations. Beginning from little, when the existence, character and extent of the ore deposits are problematical, it may increase steadily or rapidly so long as discovery and development outrun depletion, and the wiping out of the value by the practical exhaustion of the mine may be deferred for a long term of years. While not ignoring the importance of such considerations, we do not think they afford the sole test for determining the legislative intent.

As has been repeatedly remarked, the Corporation Tax Act of 1909 was not intended to be and is not in any proper sense an income-tax law. This court had decided in the Pollock case that the income-tax law of 1894 amounted in effect to a direct tax upon property, and was invalid because not apportioned according to population as prescribed by the Constitution. The Act of 1909 avoided this difficulty by imposing not an income tax, but an excise tax upon the conduct of business in a corporate capacity, measuring, however, the amount of tax by the income of the corporation, with certain qualifications prescribed by the act itself.

For this and other obvious reasons we are little aided by a discussion of theoretical distinctions between capital and income. Such refinements can hardly be deemed to have entered into the legislative purpose. Of course, if it were demonstrable that to read the Act according to its letter would render it unconstitutional, or glaringly unequal, or palpably unjust, a reasonable ground would exist for construing it according to its spirit rather than its letter. But in our opinion the Act is not fairly open to this criticism. It is not correct, from either the theoretical or the practical standpoint, to say that a mining corporation is not engaged in business, but is merely occupied in converting its capital assets from one form into another. The sale outright of a mining property might be fairly described as a mere conversion of the capital from land into money. But when a company is digging pits, sinking shafts, tunneling, drifting, stoping, drilling, blasting and hoisting ores, it is employing capital and labor in transmuting a part of the realty into personalty, and putting it into marketable form. The very process of mining is, in a sense, equivalent in its results to a manufacturing process. And, however the operation shall be described, the transaction is indubitably "business" within the fair meaning of the Act of 1909; and the gains derived from it are properly and strictly the income from that business; for "income" may be defined as the gain derived from capital, from labor, or from both combined, and here we have combined operations of capital and labor. As to the alleged inequality of operation between mining corporations and others, it is, of course, true that the revenues derived from the working of mines result to some extent in the exhaustion of the capital. But the same is true of the earnings of the human brain and hand when unaided by capital, yet such earnings are commonly dealt with in legislation as income.

So it may be said of many manufacturing corporations that are clearly subject to the act of 1909, especially of those that have to do with the production of patented articles; although it may be foretold from the beginning that the manufacture will be profitable only for a limited time, at the end of which the capital value of the plant must be subject to material depletion, the annual gains of such corporations are certainly to be taken as income for the purpose of measuring the amount of the tax

In dealing with the question whether many corporations are subject to tax, the decision says:

It seems to us that the first two questions certified must be answered in the affirmative principally for two reasons. First, because mining corporations are within the general description of Sec. 38, which comprises "every corporation, joint stock company, or association organized for profit, and having a capital stock represented by shares. . . . and engaged in business in any state or territory of the United States"; and, secondly, because the Act specifies those classes of corporations that are to be exempt from its operation, and mining corporations are not among them. Those exempted are labor, agricultural or horticultural organizations, fraternal beneficiary societies, orders or associations operating under the lodge system, domestic building and loan associations, corporations and associations organized and operated for religious, charitable or educational purposes, etc. Moreover, the section imposes "a special excise tax with respect to the carrying on or doing business by such corporation," etc. That mining companies are doing business, within the fair intent and meaning of this clause, seems to us entirely plain, for reasons already given. The conduct of such business results in profit, for it cannot be seriously contended that the ores are not worth more at the mine mouth than they were worth in the ground, plus the cost of mining. Corporations enaged in such business share in the benefits of the Federal Government, and ought as reasonably to contribute to the support of that Government as corporations that conduct other kinds of profitable business.

The third important issue raised by the case—whether depreciation should be given a special status in mining assessments is dealt with in part as follows:

It is at the same time obvious that any method of stating the account that excludes all element of gain from the process of mining must, through one process or another, exempt mining companies from liabilities to tax under the act of 1909 with respect to their mining operations. And so, an affirmative answer to the third question as propounded would be the same in effect as an affirmative answer to the first or the second. For it is a matter of little or no moment whether it is to be said (a) that mining corporations are not "engaged in business" at all, or (b) that they are engaged in business, but the proceeds of ore mined are not income, or (c) that such proceeds are income, but that there must be allowed as depreciation all that part of the proceeds which remains after paying the bare outlays of the business. In either case mining corporations would be exempt from the tax.

In our opinion, there are at least two insuperable obstacles in the way of returning an affirmative answer to the third question as certified.

In the first place, it is fallacious to say that, whatever may have been the original cost of a mining property or the cost of developing it, if in fact it afterward yield ores aggregating many times its original cost or market value, this result merely proves and at the same time measures the intrinsic value that existed from the beginning. We are here seeking the correct interpretation and construction of an act of legislation that was, at least, designed to furnish a practicable mode of raising revenue for the support of the Government, and to do this in part by imposing annual taxes upon corporations organized for profit and by measuring the amount of the contribution to be required from each corporation according to its annual income. The Act deals with corporations engaged in actual business transactions and presumably conducted according to ordinary business principles. It was, of course, contemplated that the income might be derived from the employment of property in business, and that this property might become more or less exhausted in the process; and because of this, a reasonable allowance was to be made for depreciation of it, if any. But plainly, we think, the valuation of the property and the amount of the depreciation were to be determined not upon the basis of latent and occult intrinsic values, but upon considerations that affect market value and have their influence upon men of affairs charged with the management of the business and accounting of corporations that are organized for profit and are engaged in business for purposes of profit.

And, secondly, assuming the depletion of the mineral stock is an element to be considered in determining the reasonable depreciation that is to be treated as a loss in the ascertainment of the net income of a mining company under the Act, we deem it quite inadmissible to estimate such depletion as if it had been done by a trespasser, to whom all profit is denied.

With respect to the proper measure of damages where

ore has been unlawfully mined by one person upon the land of another, there is much conflict of authority. Different modes of determining the damages have been resorted to, dependent sometimes upon the form of the action, whether trespass or trover; sometimes upon whether the case arose at law or in equity; and often upon whether the trespass was willful or inadvertent.

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Magnetite in Mattes and Slags

By J. W. Bennie*

Undoubtedly magnetite is formed from the oxidation of ferrous silicate in blast furnaces—as noted by E. W. Walter in the Engineering & Mining Journal of Jan. 25, 1913, and also in converters. The oxidation is only local, and does not account for the large amount of magnetite formed when smelting sulphide ores, especially under certain conditions.

About 16 years ago, while employed at a smelting plant on the Pacific Coast, I came across what I consider ideal conditions for observing the excessive formation of magnetite in the blast furnace. The ore being treated was a cuprous iron pyrite containing 7 to 8% copper and 45 to 48% sulphur. After a futile attempt at pyritic smelting, the management decided to stall roast the ore prior to smelting; this method of roasting answered fairly well most of the time, but occasionally instead of the ore being calcined, it was simply fused into a solid mass, consisting principally of a low-grade matte in which but little of the iron was oxidized. This material, after being broken up into proper size (by blasting) was sent direct to the smelting works. It contained but little more sulphur than what was known as "calcined ore" (the amount of sulphur varied from 20% to 23%), and was smelted as a calcined ore, using about 10% to 12% of a high-ash coke to the total burden.

As the material being treated was practically a low-grade matte, and very fusible, it was not long before troubles began. I do not remember the exact height of column of charge above tuyeres being carried at that time, but I suppose it was not above seven feet; to have carried it any higher, with the amount of blast then available, would simply have hastened the usual outcome of any prolonged efforts to smelt this material in this way; viz.: a frozen-up furnace. The freezing of these furnaces was materially hastened by the fact that the furnace jackets were made of cast iron, and, therefore, continuously leaking. (If my memory serves me aright, there were 52 jackets to each furnace, and it was not an uncommon occurrence to run one of these furnaces with one-half the jackets leaking; it varied the monotony of life around that smeltery.) The usual symptoms of a "sick furnace" were: (1) An excessive flow of low-grade matte; (2) rapid diminishment of slag flow; and (3) a thickening and sudden increase in grade of the matte. Samples of this matte showed as much as 20% Fe_3O_4. The opening of the furnaces showed excrescences—consisting of unfused quartz and lime surrounded by magnetite—from the tuyeres to a height of 3 ft. or 4 ft. above. It was quite evident that magnetite was produced from the oxidation of iron sulphide at too low a temperature to form slag.

The reaction $3\ FeS + O_{10} = Fe_3O_4 + 3\ SO_2$ occurs in all pyritic, or semi-pyritic smelting, and the formation of magnetite is the cause of the usual disasters attending pyritic smelting where there is insufficient heat being produced to cause the de-oxidation of the magnetite to ferrous oxide, or where the oxidation of the sulphides is not attended by sufficient heat to form ferrous silicate.

Conditions much like I described, existed some years ago at Mount Lyell, where in their "secondary pyritic process" of oxidizing and concentration of low-grade matte in the blast furnace, large quantities of magnetite was formed shortly after the blowing in of the furnace; there was a rapid accumulation of magnetite and unfused quartz, and this accumulation continued until smelting entirely stopped; the period elapsing between blowing in of the furnaces and their shutdown varied from four to six days. The management properly considered that in spite of the muscular metallurgy entailed the cost was materially less than that of any ordinary process for concentration of matte.

The reaction $FeS + 10\ Fe_2O_3 = 7\ Fe_3O_4 + SO_2$ occurs in the roasting of sulphide ores in MacDougall, or similar furnaces, if the temperature of the mixture of oxides and sulphides is suddenly raised. This reaction probably also occurs in blast and reverberatory furnaces.

A contributor, writing in the Journal of Nov. 1, 1913, on the subject of "Reduction of Ferric Oxide by Ferrous Sulphide," states that there is no such reaction as

$$FeS + 3\ Fe_2O_3 = 7\ FeO + SO_2$$

If such be the case, it will certainly surprise Peters and other metallurgists who use this reaction as the basis for determining the grade of the matte, or the amount of iron that will form slag, from any given mixture, in a reverberatory furnace.

It is true that Roberts-Austen shows this reaction as exo-thermic instead of highly endo-thermic (probably a printer's error) but it occurs nevertheless in reverberatory smelting. That Fe_2O_3 and Fe_3O_4 can be, and are, de-oxidized by means of FeS must surely be admitted; it is simply a matter of temperature.

The mere raising of the height of column of charge in the blast furnace does not necessarily mean the elimination, or non-formation, of magnetite. At the Shannon works, where we treat a mixture of minerals containing copper, varying from garnets to porphyries and where the saving of sulphur was at one time a matter of great moment—we carry a column of charge 12 ft. above the tuyeres, but this does not prevent formation of magnetite, more especially when we are forced by circumstances to make a high-fusion-point slag. The slightest cooling of the furnace at the tuyere zone, and the formation of excrescences immediately above tuyeres, is always accompanied by the formation of magnetite.

As Mr. Flynn is aware, sulphide ores are successfully smelted in this district in furnaces with a column of not more than 5 ft. above tuyeres, with no abnormal formation of magnetite.

The formation of magnetite in a blast furnace is dependent, therefore, on factors other than height of the smelting column. The chief factor is, I consider, the oxidation of the iron sulphides under conditions (such as insufficient temperature) which are not favorable for the formation of ferrous silicate. Where magnetite is used as part of the blast-furnace charge, its reduction would, therefore, depend on heat and carbon, or heat and sulphides. Both reactions would cause de-oxidation.

*Manager, Shannon Copper Co., Clifton, Ariz.

Nitrogen Fixation in Scandinavian

The carbide works at Odda, Norway, when operations were started, comprised 10 furnaces, each with a capacity of 7 to 8 tons of carbide per 24 hours (*Times Eng. Suppl.*, Oct. 15, 1913). Ten more furnaces, of 16 to 18 tons capacity each, have recently been added. The temperature is maintained at 5720° F., the electrodes of the older furnaces taking 1400 kw. and those of the newer ones, 3500 kw. It is stated that the radiation of heat from the new furnaces is less than from a steam boiler. The hot gases from the furnaces are used in the lime-kilns instead of producer-gas. The annual output, 32,000 tons up till recently, is now 80,000 tons of carbide.

Most of this carbide passes direct to the calcium cyanamide works of an associated company, which at the present time has an annual output of 80,000 tons, the number of furnaces having been increased nearly sevenfold since the opening of the works four years ago. The nitrogen used is prepared by the Linde process, 100 tons of air being liquefied daily. The furnaces have a capacity of 1 ton each; the nitrogen is supplied through valves in the side, and a current at 60 to 75 volts through an electrode in the center. After about 24 hours at 1650° F., the carbide is converted into cyanamide, the resulting product containing 20% of nitrogen. In addition to these developments, a company formed to acquire the rights of the Ostwald process (except in Westphalia and Rhineland), is erecting new works for the manufacture of carbide and cyanamide (and nitric acid) at Aura, Norway, with an estimated output of 200,000 tons of calcium cyanamide, and has acquired waterfalls at other places in Norway and also in Iceland, capable of furnishing power for an annual output of nearly 2 million tons of calcium cyanamide.

Works are to be erected at Dagenham on the Thames, at Trafford Park, Manchester, in Scotland, and in Ireland for producing from calcium cyanamide, 12,000, 12,000, 9000 and 3000 tons of nitric acid respectively. In the event of the supply of calcium cyanamide being curtailed or stopped, it will be possible to use the ammoniacal liquors from coke-ovens, blast-furnaces, residual recovery plant, and gasworks as sources of ammonia.

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Messina Development Co.

According to the annual report of the Messina Development Co., Transvaal, South Africa, for year ended June 30, 1913, the total production of the company to date is as shown in the following table:

Year	Tons of Ore Milled	Tons Concentrates Produced	Average Assay % Copper
1906	476	280 0	66.0
1906-1907	2,967	768.5	60.6
1907-1908	5,183	1148.8	58.3
1908-1909	15,011	2240.2	52.3
1909-1910	23,578	2758.3	50.0
1910-1911	18,573	2503.4	50.8
1911-1912	10,347	1162.1	49.8
1912-1913	22,601	3602.1	45.8
Total	98,736	14,463.4	50.9

The ore reserves at the end of the year were estimated to contain 230,000 tons of ore averaging 10% copper. The grand total of development work, including shafts, amounts to 33,620 ft. With the total production, 98,736 tons, and ore reserves, 230,000 tons, total, 328,736 tons, it has evidently required 1 ft. of development work and shafts for every 9.77 tons of ore developed to date. The production for the year consisted of 3602.11 tons of copper concentrates averaging 45.8% cu. and 2591 tons of middlings averaging 11.6% cu.; total, contents 1953.16 tons of copper. The cost of producing and delivering the 3602 tons of concentrates to Swansea is summarized as follows:

	Per Ton of Concentrates
Mining, milling, sorting, bagging and development redemption	$49.77
Salaries, fees, insurance and general charges	5.61
Wagon and rail freights, ocean freights, insurance, agency, etc.	22.59
Total given in table as shown in report..	$77.97
To this must be added London office expenses, directors' fees, taxes, etc.	15.10
Total as indicated by profit and loss statement	$93.07

Development work consisted of 3186 ft. of drifts; 1378 ft. of crosscuts; 761 ft. of winzes; 920 ft. of raises and 400 ft. of stations; total, 6647 ft. This work was done at an average cost of $15.94 per ft. Development was charged off at the rate of $2.43 per ton of ore milled.

The main No. 5 shaft was sunk to a depth of 678 ft. from the surface, or 659 ft. for the year. The cost of this shaft, including masonry and concrete work above the first level, has averaged about $58.50 per ft. It is to be equipped with a 72-ft. steel headframe, two 3-ton skips, safety hooks, storage bins, etc., and a 22x48-in. duplex direct-acting Corliss winding engine with 8-ft. drums. The hoist will have a capacity of seven tons working to 2000 ft. in depth.

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Rhodesian Mining Notes

SPECIAL CORRESPONDENCE

No important discoveries have recently been made by prospectors and this fact is disquieting as far as the future is concerned. Two of the largest producers in the past show signs of exhaustion. The ore reserve of the Eldorado mine is reduced to 36,000 tons valued at 22 dwt. The main shoot of ore having contracted in length from 600 ft. to 710 ft. in the lower level. The Giant mine is simply milling developed ore, exploration work having failed to disclose any extension of the orebody. This company will probably take up and develop claims from the Cam & Motor Company.

There are several new producers coming forward to maintain the output. The Shamva mines have now 2,325,000 tons developed, valued at about 20s. recovery value, and they are erecting a large plant.

The Bell Reef has 42,000 tons valued at 48s. per ton fully developed and is erecting a plant to heat 4000 tons per month. The Golden Kopje, Connemara, Antelope, Enterprise and Eileen Alannah mines will shortly be producing, but the finest mine in Rhodesia will probably be the Cam & Motor mine, which has 1,000,000 tons of ore valued at 46s. fully developed and on which the erecting of a milling plant on West Australian lines to treat 15,000 tons of ore a month, is nearly completed.

The Falcon mines have 800,000 tons of gold-copper ore valued at about 60s. per ton, but I anticipate high working costs and poor recoveries from this deposit. The tin deposits have proved unpayable. The Lonely Reef Gold Mining Co. has 180,000 tons valued at 80s., developed and crushed in three months 14,600 tons for a recovery of 17.3 dwt. Working costs were 27s. 6d. per ton with 3s. 8d. government royalty.

DETAILS OF PRACTICAL MINING

Method of Supplying Steam-Shovel Water

The steam shovels in the Mesabi openpits obtain their water from the tenders of the locomotives handling the loading trains. The ordinary method of transferring the water is to use an injector on the shovel to create a suction in a rubber hose from the tender tank. The hose is expensive, costing about $100, and is subject to rough usage, which soon creates leaks and renders it unavailable

PIPE FOR SUPPLYING WATER TO STEAM SHOVEL

for suction purposes. Butler Bros., stripping contractors, have developed a more satisfactory method. The tender carries a 4-in. pipe arranged to swing over the shovel and make connection readily, the water being forced over by an injector on the tender, using locomotive steam. The illustration shows the manner of arrangement. A 1-in. steam pipe supplies the injector. The water pipe has several ells to give it flexibility in every direction. The connection to the shovel pipe is made with an ordinary screw union. Several rests on the tender support the pipe when not in use.

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Relative Merits of Storage Battery Types

Writing in *Power* Nov. 18, 1913, Eugene Oster discusses the lead-sulphuric and Edison types of storage battery, and derives the following conclusions as to their relative advantages:

(1) The principal advantage of the lead cell lies in its high efficiency and low first cost.

(2) Among the innate disadvantages of the sulphuric-acid battery can be mentioned: Excessive weight; structural weakness of parts; corrosive nature of electrolyte and fumes; loss of capacity; shedding of active material; exacting and incessant care required for successful operation; fracture and buckling of plates; sulphation; internal discharge; high installation and maintenance costs.

(3) The advantages of the Edison cell are: Increase of capacity with use; simplicity of the care required; ease of interconnecting the cells; steel-preserving electrolyte and lack of corrosive fumes; durability and sturdiness of cell structure; low weight per unit of capacity; ability to withstand short-circuits; absence of sulphation, buckling and sediment; immunity from injurious effects of overcharge; low maintenance cost.

(4) The disadvantages of the Edison cell may be summed up as high initial cost and comparatively low efficiency, due to low cell voltage.

It is thus evident that each type of battery has its special field, and, hence, a satisfactory selection can be made only after an exhaustive investigation of all the factors entering into an installation.

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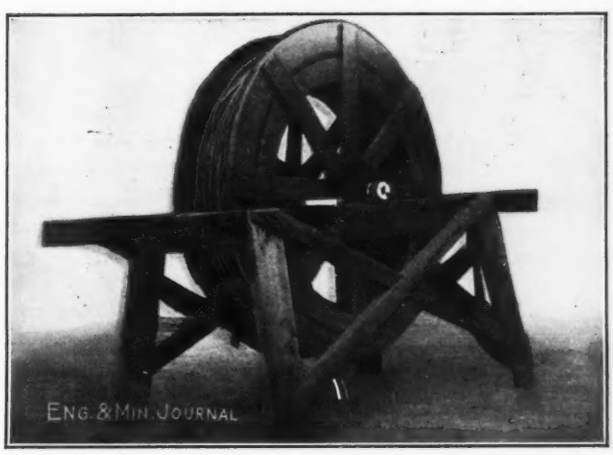
Reel for Stockpile Trolley Wire

The system of stockpiling followed on the Mesabi and Vermilion ranges involves the extension of the pile in several faces, served by a series of tracks branching off the main track from the headframe. The ore is trammed out in end-dump cars by electric-trolley locomotives. The trolley wire must thus be continually extended. It is usual to keep the coil of extra wire hung on a support at the end of the track. For the Oliver mines at Ely portable reels are provided and are kept on the stockpile floor



WOODEN REEL FOR CARRYING EXTRA TROLLEY WIRE IN STOCKPILING

some way out from the toe of the advancing dump. The wire, as it leaves the top of the dump, is carried out on a horizontal boom so that it clears the dump face by from 10 to 20 ft. at all points and is out of danger of the falling material. The reel itself is built of 1-in. lumber and is 4 ft. in diameter and 10½ in. across the face where the wire winds, the flanges being 5 in. deep. The frame carrying the reel is of 2-in. lumber for the most part and is provided with barrow handles at the end to facilitate moving it about. The reel has an iron axle mounted in split porcelain insulators as bearings, to obviate any danger of short-circuiting.

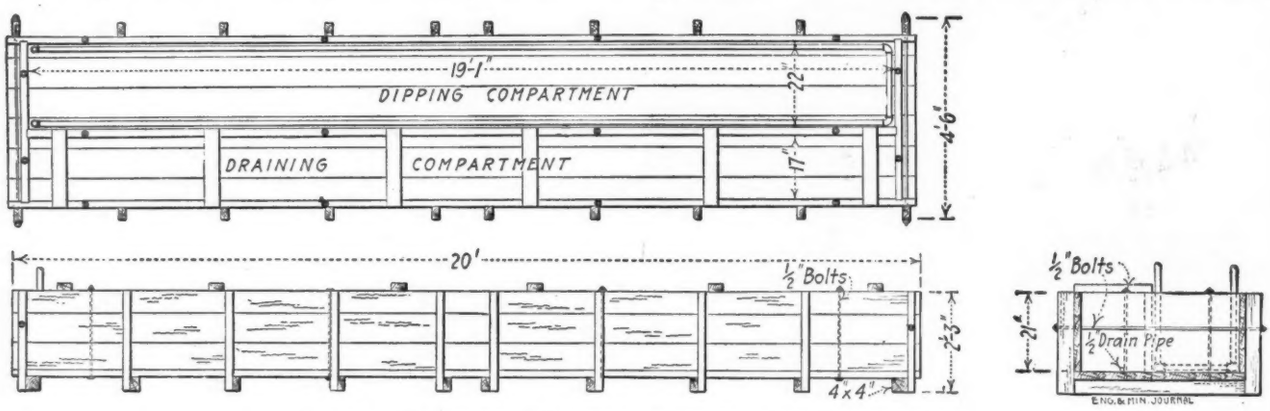
Dipping Tank for Mine Timber

By L. O. Kellogg

At the Bennett mine, on the Mesabi, Carbolineum is rather extensively used for treating timber for both underground and surface construction. The material for such surface structures as the coal trestle and the casing on the vertical water-tank pipe and for the shaft sets and station timbering underground is dipped in the preservative before it is put in place.

The tank used for the purpose is simple enough, but has proved convenient and is so readily constructed as to merit description. It is built of 2-in. lumber throughout, except that the two end sills are 4x4 in. Its length is such as to accommodate the wall plates of the shaft sets, the longest pieces which require treatment. The boards in the box itself are tongue-and-grooved and are bolted together to get tight joints. A longitudinal, vertical partition divides the tank into two compartments, one for dipping, the other for draining, the former somewhat the larger.

The box is bound with sets of 2x4-in. material, consisting of a sill and two posts each, spaced about 2 ft. apart. The dipping compartment is lined bottom and sides to a height of about 18 in. with galvanized iron nailed to the wood and soldered at the joints. A steam coil on the bottom along the sides and one end keeps the Carbolineum slightly warm, to obtain a more rapid penetration. The timber is allowed to soak for a few minutes and then lifted out to drain on several 2x4-in. cross-pieces above the drain compartment.



Wooden Tank for Treating Timber with Preservative

Rock Drill Inspection

At the Village Main Reef on the Rand, every rock drill is brought up from underground at regular intervals and thoroughly overhauled ("Journ. So. African Inst. of Eng.," November, 1913). This includes reaming the cylinders and grinding the pistons to a standard fit. A record is kept of each machine and it is not allowed to stay underground more than three months. This greatly reduces the consumption of air, a point of particular importance here as in many Rand mines, since air is bought by the unit, and its cost varies directly as the quantity consumed. Where a mine generates its own air, this correspondence does not exist, the utilization of the total compressor capacity involving only a slightly greater cost than a partial utilization.

Handling Telephone Cables in the Mine*

The following kinds of conductors are in general use for wiring mine-telephone systems: (1) Cable; (2) braided rubber-covered, copper-steel or hard-drawn copper wire; (3) bare No. 10 B.B. double-galvanized iron telephone wire. When properly designed and manufactured, cable is perhaps the best type of conductor that can be employed for mine-telephone circuits.

Lead-covered cable, used to some extent, has in many cases given trouble. The metal covering is subject to attack from dilute acids, both organic and inorganic; it is extremely difficult to prevent electrolytic action, especially if metal supports are used; the lead sheath is mechanically weak, necessitating support at frequent intervals, while the constant jarring of the car or cage is often sufficient to cause crystallization and consequent parting of the cable.

Another type of cable now manufactured by the Western Electric Co., is especially adapted for use underground. This is known as circular-loom cable, and is composed of braided rubber-covered twisted pair wires with jute filler, over which is woven a circular loom of heavy cotton impregnated with a waterproof compound. The circular-loom covering differs from that ordinarily employed, in that the strands are laid longitudinally and transversely, instead of being braided diagonally. This makes a much stronger fabric, as the pull on the cable is resisted by the heavy longitudinal strands. The standard type of cable contains a special rubber insulating compound, well adapted to withstand mine conditions. If desired, however, wires insulated with a high-percentage rubber compound can be supplied. The cable can be furnished with any size conductors desired, but the No. 14 B. & S. hard-drawn copper or No. 16 B. & S. copper-clad are recommended.

Cable is superior to other forms of conductors for carrying the telephone circuit down shafts. On account of its construction it will maintain its insulation better than single wires, and being a single strand it is easier to protect and install than are two or more wires. Armoring, composed of spirally wound galvanized steel wires, is often employed to protect shaft cable from falling material.

*An abstract of an article by Gregory Brown, of the Western Electric Co., "Coal Age," Dec. 6, 1913.

Fig. 1 shows a method of supporting the cable as well as protecting it, and consists of a wooden casing covering the entire length of the conductor, the back being grooved to fit the cable approximately and the cover fastened down in such a manner as to exert a clamping pressure. Another effective method of protecting cable is to run it through conduit or piping.

When the shaft is of considerable depth, it is necessary to support the cable by means of suitable clamps placed in iron boxes provided with covers to exclude the moisture. These boxes are either tapped for the pipe, or locknuts and rubber washers are employed. A box and clamp are shown in Fig. 2. When the shaft is not too deep, one such clamp at the top is generally sufficient. When a cable fastener is being attached to its support in the shaft, it should be so placed that there is a trifle of slack between it and the next preceding clamp. By proceeding thus, it will be assured that each support is carrying only its proper length of cable.

There are several methods employed for running cables in roads and entries. Where the road is timbered, it is good practice to fasten the cable to the sets by means of insulated iron clamps or porcelain cleats. The insulated iron clamp is shown in Fig. 3. It is fastened to the timber by means of wood screws. The porcelain cleat of Fig. 4 is more easily broken. The clamp and cleat of the size shown are suitable for two-conductor circular-loom cable, but can be furnished with various-sized openings adapting them for cable larger than the two-conductor.

In order to avoid injury, it is advisable to run the cable in an upper corner of the drift. Cable back of the timbers is poor practice, as it is difficult to get at in case of trouble. Where there is no timbering, it is satisfactory to suspend the cable from the back. A good method of doing this is shown in Fig. 5. A piece of 1¼-in. pipe, 8½ in. long, is split with a hacksaw for a distance of about 3 in. from one end. In this end of the pipe is inserted a metal or wooden cone, the largest diameter of which is slightly smaller than the outside diameter of the pipe. At the other end of the pipe there should be drilled in a transverse direction two holes, suitable for bolts to hold the cleats. A hole is drilled in the back for a distance of about 5½ in. The pipe plug is driven home in this hole. Where the back or sides are of such material as to make it difficult to provide a fastening, the pipe is made much longer, and the hole deeper.

Another somewhat less expensive method of support is shown in Fig. 6. A special creosoted wooden expansion plug is used which has a hole through its center, and is also slit halfway through. At the rear is a conical opening, into which fits a wooden cone; this expands the plug when the latter is driven home. A split knob, as illustrated, is then screwed into position.

This method is not quite so strong, but in cases where the rock is good it has been used with success, care being taken to support the cable at frequent intervals. Where the pipe is used, a distance of 20 ft. between supports has been found satisfactory. Where the back is uneven it is often necessary to increase this distance. The cable should at no point touch the roof.

Cable is sometimes run in a conduit and in some cases this has been fastened to the ties. This serves as a good protection for the conductors, except in case of wrecks. There have been cases also where armored cable has been employed on roadways. This possesses great strength and ability to resist crushing, a feature important as making it possible to communicate with men behind a fall of ground. A good way to install armored cable is to place

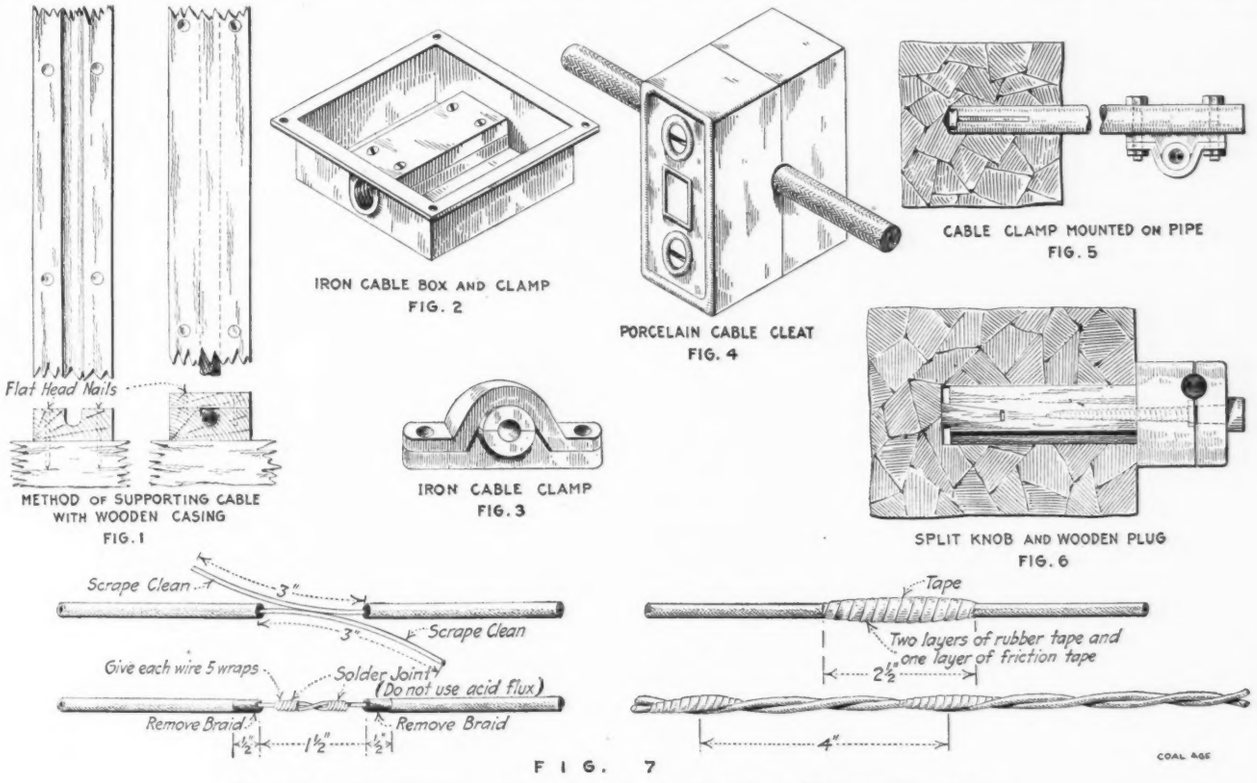


FIG. 7

MEANS OF PROTECTING, SUPPORTING AND SPLICING TELEPHONE CABLE

it in a shallow trench upon a layer of sand. Rough boards are then laid over the cable, and the trench filled in, the office of the boards being to eliminate danger from picks or crowbars.

In making repairs or in joining one length of cable to another, the splicing operation should be performed as follows: The cable insulation is removed for a distance of about 8 in. from the end of each piece, leaving the braided, rubber-covered wire exposed. Over one end is slipped a piece of circular loom of sufficient length to cover the whole joint when completed. One of the projecting wires in each cable is then cut off so that it extends a distance of about 4 in. The rubber insulation is removed from each end of the four wires for a distance of 3 in., care being taken to see that the wire is not nicked. The short wire of one cable is then twisted around the long wire of the other, as shown in Fig. 7. Each joint is soldered, using rosin core solder for the purpose. Ordinary soldering salts should on no account be used, as it is impossible to get rid of all the acid, and its presence will cause corrosion. After soldering, the braid on each wire is removed for a distance of ½ in. and each joint is covered with two layers of pure rubber tape, starting the tapping operation on the rubber insulation from which the braid has been removed, and terminating it upon the insulation on the other side of the joint. Okonite tape is highly suitable for this purpose. One layer of adhesive tape is applied on this and starting from the cable sheath, two layers of adhesive tape are wound around the two wires together. After this the circular loom is slipped back over the joint and taped in position.

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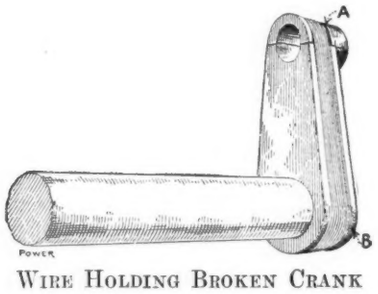
Broken Crank Repaired with Wire

A small crank on a pump broke through the crankpin bore, according to G. A. Robertson, *Power*, Dec. 16, 1913, and the upper half of the crank fell entirely off. Circumstances were such that it was necessary to make a quick repair on the spot.

Slots *A* and *B* were filed in the small and large ends of the crank. The pin was placed in position, the broken



WIRE HOLDING BROKEN CRANK

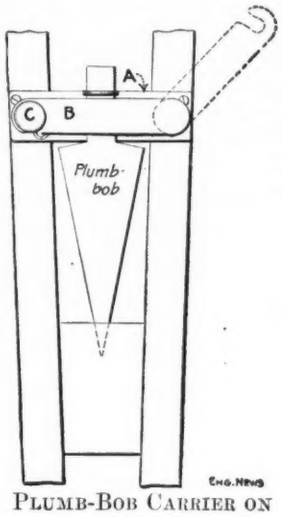
part placed over it and fine steel wire was then wound around the crank until the slots were filled. Over this one round of large copper wire was placed to hold the fine wire, which would break when attempting to tighten by twisting it. The pump operated satisfactorily for several days, the wire remaining in position.

❖

Congress Recently Granted the U. S. Geological Survey $50,000 to cover part of the damage done by the fire of last May, which occurred in one of the rented buildings occupied by that bureau, consuming or ruining a large amount of property and publications.

A Plumb-Bob Holder

An ingenious device for carrying a transit plumb-bob is described in a recent issue of *Engineering News*: The cut shows the device ap- The point of the plumb-bob rests in a ¼-in. hole bored ½ in. deep in the spacing block of the leg, while its neck fits between two strips of brass. The inner strip *A* is secured by two screws The outer strip *B* is hinged at one end, while the other end is notched to hook over a pin *C*. This pin is fitted as a clamp screw, so that by a slight turn of the milled head the plate is held firmly in place. Both plates are slightly bent at the middle so as to allow for the neck of the plumb-bob and the string which is wound around it.



PLUMB-BOB CARRIER ON A TRIPOD

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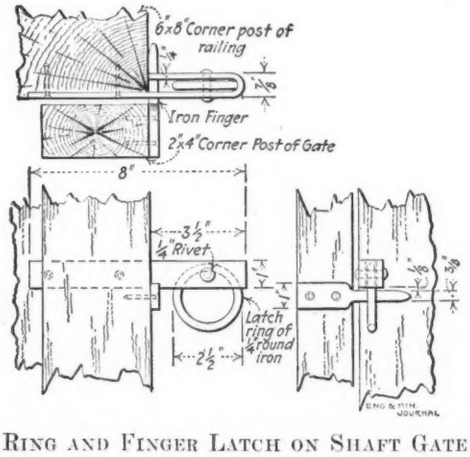
A Handy Gate Latch

The gate latch herewith illustrated is one used at the Bennett mine, Keewatin, Minn. While in this particular instance it was applied to the gate into the manway, through the fence around the shaft collar, it is suitable for any gate and is extremely neat, reliable and convenient. It consists of a horizontal finger attached to the gate and a ring held loose in a double-strap hanger fastened to a corner post of the fence. The 2½-in. ring rests on a ¼-in. rivet between the two straps. In closing the



RING AND FINGER LATCH ON SHAFT GATE

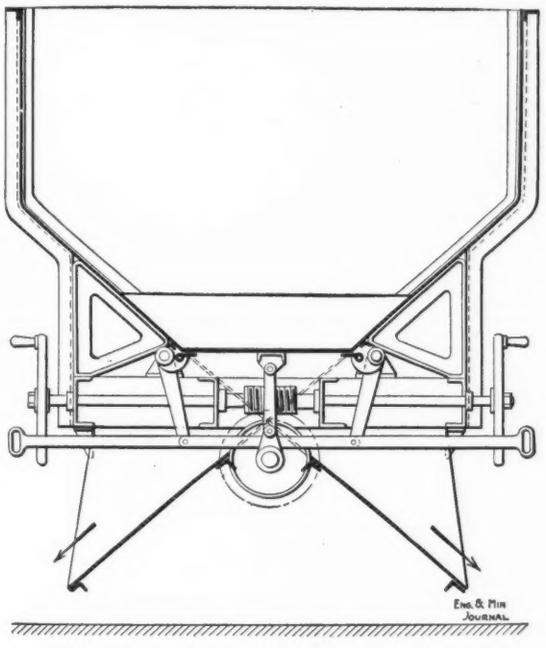
gate the finger strikes the ring, which is so positioned as to move freely inward and upward and allow the finger to pass. The gate cannot open by itself, as the finger strikes above the center of the ring so that the latter cannot lift; nor can it swing outward, since it strikes the closed end of the double strap; the latch is released by lifting the ring with the hand.

DETAILS OF METALLURGICAL PRACTICE

The Kluseman Ore Car

At the Simmer Deep mine, on the Rand, a broad-gage railway is in use for the joint reduction plant of the Simmer Deep and the Jupiter Gold Mining Co. The ore is supplied by four shafts, all provided with sorting and breaking plants, and the broken ore is hauled to the mill, the maximum distance being 9000 ft. and the average distance, 7000 ft.

Steam traction is used, the locomotive weighing 48 tons, and it has four axles, all of which are driving axles. The ore cars in use are the ordinary bottom discharge hopper cars originally used for hauling coal on the South African Ry., carrying 40 tons, and special ore cars of the



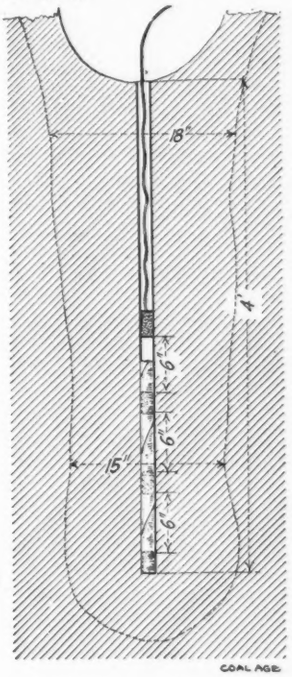
AN ORE CAR USED AT TRANSVAAL MINES

Klusemann type, with side-discharge doors and carrying 35 tons of ore. The design of the Klusemann car is shown in the accompanying illustration. The weight of the Klusemann car is 13 tons and of the other car 22 tons. The train usually carries from 160 to 200 tons of ore. The steepest gradient is 3%, and this prevails on the approach to the mill. The sharpest curve has a radius of 400 ft. In the Simmer Deep and Jupiter mills, the train runs over the mill-ore bin, which has been designed to carry the extra load.

At the Simmer & Jack mines, the average cost for three months, during which time 204,500 tons of ore were moved, was per ton of ore hauled, 2.108c., and per ton-mile, 1.72c.; the number of trains hauled having been 1583; the number of trucks hauled, 7916; the ore hauled per train, 129 tons; the ore hauled per truck, 28.8 tons; the weight of locomotives, 46 tons; the bare weight of one truck, 11.5 tons.

Blasting Pole Holes

The holes made for telephone, trolley and other poles can be blasted by electricity, according to *Dupont Magazine*. The holes should be 4 ft. deep for a 20-ft. pole to 7 ft. for a 50-ft. The average hole is 4½ to 5 ft. deep. Poles are set for telephone service 150 to 175 ft. apart with an average of 35 to the mile. The holes have a diameter varying from 14 to 18 in. The cost of digging holes for 25-ft. poles by post-hole diggers is about 58c. each.



ARRANGEMENT OF CARTRIDGES FOR BLASTING POLE HOLES

When blasting the holes by dynamite, the explosive should be distributed in the hole, as a charge at the bottom only, does not open the hole at the surface. A 4-ft. punch bar can be used for making the cartridge hole. It can be driven into place with a sledge and if knocked sidewise when driving can be removed without difficulty.

As the dynamite must be distributed, much time can be saved by making up cartridges of paper, 4 ft. 6 in. long, by rolling stiff wrapping paper round a stick of proper diameter and fastening four quarter sticks of 40% dynamite about 6 in. apart beginning at the bottom, as shown in the figure.

These small cartridges can be kept in place by the use of ordinary pins, stuck through the walls of the paper tube. This spaces the dynamite plugs properly and leaves a free space between them, thereby insuring the firing of the lower pieces, the cap always being placed in the top piece. Without the paper tube, there is some danger of the lower pieces not exploding, especially if much loose dirt intervenes. Water does not affect the proper exploding of the lower pieces, but loose soil does. A convenient way of placing the pieces of dynamite is to have a stick with marks 1, 2, 3, 4, etc., on it, and push the pieces into the tube one at a time and pin them in place.

The fuse need project only 2 or 3 in. above the surface, and should be bent to one side. The operator is safe in staying within a few feet of the hole, when the dynamite is exploded, as there is no general upheaval of earth. An ordinary post-hole digger is desirable for removing the loose earth. No digging bars are necessary, the earth being well broken. The average time for cleaning is from

5 to 10 min. The explosion hardens the sides of the hole and makes tamping around the pole, when set, less laborious. About 30 to 50 holes a day can be made by five men.

Calcining of Gypsum

The principal commercial value of gypsum arises from the fact that at the moderate temperature of 130° C., three-fourths of its water of crystalliztaion is expelled, yielding plaster of paris. Water begins to come off below 100° C., but very slowly up to 130°. At 163° C. more water is expelled, and if a temperature of 221° is not exceeded, the resulting plaster is still serviceable, but if calcined above that temperature, the plaster becomes increasingly slow to set with the addition of water. At 343° C. gypsum is completely dehydrated, and the "dead burned" plaster loses all hydraulic properties, becoming $CaSO_4$, or anhydrite.[1]

In practice, two dissimilar methods are employed for calcining gypsum. The older method uses kettles holding up to 25 tons. The gypsum is first pulverized by passing successively through jaw crushers, gyratory crushers, and buhr mills, and is then charged slowly into the kettles, which are heated from outside and are provided with interior stirring devices. In about 1 hr. after filling, the mass reaches a temperature of 230° F. and begins to "boil" by rapid expulsion of water. When it reaches 350° F., the plaster is discharged into a cooling pit, and is afterward screened, the coarser grains being reground.

The more modern Cummer continuous process utilizes a rotary kiln through which furnace gases and hot air are drawn by fan. In this method, the gypsum is crushed only to nut size before being fed automatically and continuously into the kiln. It passes through the kiln in about 10 min. and is discharged at a temperature of nearly 500° F., which, however, is not sufficient to "dead burn" the gypsum owing to the presence of moisture which is not fully expelled during the short stay in the kiln. The hot gypsum is then stored in brick bins, where the mass acquires a uniform temperature just sufficient to produce plaster paris of the right quality. The calcined lumps are then pulverized and sifted. The advantages of the latter method are (1) that less than half so much fuel is required per ton of output, owing to the continuity of the heating, and (2) less power is required to pulverize calcined than raw gypsum.

Concentration of Sliming Minerals

A rather neat idea for the treatment of ores in which the valuable material is one which slimes readily, is given by Orr Johnson Adams, of Grand Junction, Colo. (U. S. pat. 1,070,313). Such are certain vanadium and uranium ores. These he crushes, breaking the quartz grains as little as possible, then classifies wet.

The slime is usually comparatively high in valuable material, the coarse is low. The coarse material is then leached with some acid which is a solvent for the materials desired. This is a cheap process, as the coarse material is quickly leached, and there is usually only a small percentage of acid-consuming impurities in it.

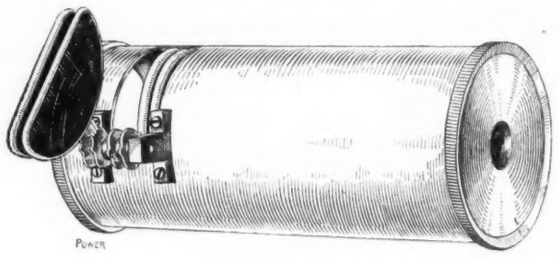
[1]Extract from Bulletin 11 of the Oklahoma Geological Survey, by L. C. Snider.

The solution, after being sufficiently neutralized by successive applications to the coarse ore, is then mixed with the previously separated slime. The impurities in this material will precipitate the valuable materials (such as vanadium, uranium, etc.), giving all of the original valuable material in a slime concentrate of small bulk. This concentrate, then, can afford comparatively high freight and treatment charges.

Standard Umbrascope Smoke Tester

This instrument has been designed for use in cities and towns where the smoke ordinances for the regulation of the density of smoke are in force. The method employed in determining the density of smoke is by comparison with smoked glass of certain light-absorbing power, says *Power,* Dec. 2, 1913.

The tester, or umbrascope, which is manufactured by Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia, Penn., consists of a nickel-plated tube, 1½ in. in diameter and 4 in. long. Near one end of this tube are four smoked glasses, in the shape of half circles, so



SMOKE TESTER

hinged that one or all of them may be swung into the tube at once, which clouds the view through one-half of the tube. The clear sky is viewed through the other half of the tube and through as many glasses of specified density as the law requires. A comparison between the glass and the smoke decides which is the darker.

Sprague's Method for Lead Arsenate

The customary method of manufacturing lead arsenate is to precipitate the compound from solution. According to C. B. Sprague, of the United States Smelting Co., this substance may be formed by roasting compounds containing lead oxide and arsenious acid together (U. S. pat. 1,064,023). These ingredients need not be in molecular proportion, if an excess of arsenious oxide is present it is more or less completely expelled, while an excess of lead simply remains as some one of the oxides, in the fused material, and finally in the leached residue. In practice speiss and litharge are used, about 4.4 lb. of litharge per pound of arsenic in the speiss producing about six pounds of lead arsenate.

These are roasted with access of air, and the roast conveyed to leaching kettles and extracted with 25 to 30% caustic-soda solution, about 1.5 lb. of caustic per pound of lead arsenate. After leaching, the solution is filtered from the insoluble residue, and the alkali neutralized with acetic or nitric acid, precipitating the lead arsenate. "The acid may then be regenerated by an appropriate method."

THE COST OF DOING THINGS

Summary of Machine-Drill Data

The following data were compiled from articles which have already appeared in the "Cost of Doing Things." For more details of operating conditions reference may be made to articles under the name of the operating company.

Alaska Treadwell mines, Douglas Island, Alaska: Average tonnage secured in stopes per machine drill shift, 34.7 tons; drilling rate, 28 ft.; length of shift, 10 hr. In drifts, 3¼ Ingersoll-Rand drills are used, it requires 40 min. to set up machine and the drilling rate is 33 ft. per shift. Records for 1911 at the Alaska Treadwell, United and Mexican mines show that the rate of drilling per machine shift in stoping ranged from 28.58 ft. to 32.71 ft.; in development, 33 to 41 ft. On the Ready Bullion claim 57.7 tons were secured in stopes per drill shift.

British Columbia Copper Co., Motherlode group, Greenwood, B. C., using a Sullivan 3¼-in. U F-2 drill, an average of 31 ft. of holes are drilled per 8-hr. shift. About 118 tons are secured per drill shift in stopes.

North Star Mines, Grass Valley, Calif., operates on an average of eight piston and 45 hammer drills daily. In drifts it requires 1.75 hr. to set up machines on vertical bars, including time required to clean out face. To rig a machine on horizontal bar takes 35 min. About 43 ft. of holes are drilled per 8-hr. shift with No. 8 water Leyner drills. In stopes 12-A Waughs usually drill 25 ft. of holes in 5⅔ hr. actual drilling time, 5.64 tons are secured per drill shift.

Mammoth Copper Co., Mammoth, Calif. At this mine about 38 tons of ore are broken in stopes and 1.6 ft. of advance made in development per drill shift. Operating 34 piston and five hammer drills requires 902,300 cu.ft. of air per day. It requires about an hour to set up drills in drifts, making two set-ups the average drilling rate is 60 ft. of holes per 8-hr. shift. In stopes, Ingersoll Sergeant D-24 drills average 45 ft. of holes per shift.

Erie Consolidated mine, Gaston, Calif., operating two piston and three hammer drills consumes 360,000 cu.ft. of air per day. In drifting 1½ hr. is required to muck back and ½ hr. to set up a machine, with two set-ups 55 ft. of holes are drilled in an 8-hr. shift. In stopes 8-C Waughs drill from 36 to 54 ft. per shift.

Pittsburg Silver Peak, Blair, Nev., water Leyner and Ingersoll-Rand piston drills are used in development, about 35 ft. of holes are drilled in an 8-hr. shift and 3.5 ft. of advance made. In stopes, 45.5 tons of ore are secured or 45 ft. of holes are drilled per drill shift with air hammer drills.

Cananea Consolidated Copper Co., Cananea, Mex. In drifts the drilling rate is approximately 40 ft. per 9-hr. shift, allowing 40 min. for set-up. In stopes the rate is 90 ft. with Ingersoll B C-21 stoper drills.

Ohio Copper Co., Bingham Cañon, Utah. This mine secures about 44.6 tons per drill shift worked in the mine including development. In drifts an average of 24.5 ft. are drilled in 8-hr. shifts allowing for two set-ups of one-half hour each. In stopes, the average for Waughs is six 6.5 ft. holes or 39 ft.; and for 3½-in. Sullivans, five 10-ft. holes or 50 ft. of holes.

Liberty Bell mine, Telluride, Colo. In stopes, 37 tons are secured per 8-hr. drill shift and from 75 to 80 ft. of holes are drilled with Ingersoll B C-21 stopers. In drifting Ingersoll C-110 2¾ drills, making two set-ups and including time required for picking down, drill about 45 ft. of holes per shift.

Dome Mines, Porcupine, Ont. During a three-month period ended Mar. 31, 1913, Ingersoll-Rand No. 43 piston drills in drifts averaged 36 ft. of holes per 9-hr. shift and broke 1.68 linear ft. of drifts. In raises Rand B C No. 26 Butterfly hand hammer drills averaged 16.5 ft. of holes and broke 0.62 ft. of raise per shift. In stopes, 43.7 tons of ore were secured per shift and the drilling rate averaged from 30 ft. of holes for piston drills to 38.7 ft. for air hand hammer drills.

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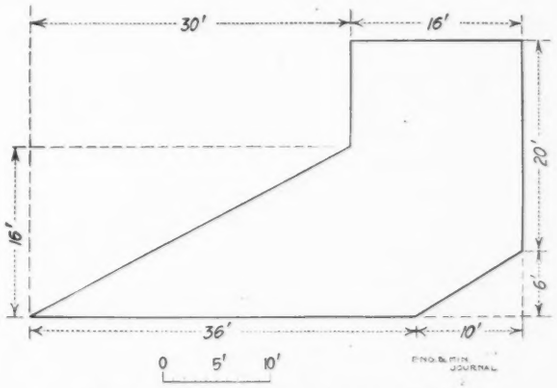
Steam-Shovel Work

The following is an extract from a "Hand-Book of Steam Shovel Work," p. 236, issued by the Bucyrus Co., and is a record of shovel No. 1083 of the Oliver Iron Mining Co., Seller's Pit, Hibbing, Minn. This shovel was working in the soft ore typical of the Mesabi range. There was some taconite mixed with it and some "paint



BLASTING FOR STEAM-SHOVEL WORK

rock." These materials did not occur in the form of regular intrusions, but were scattered through the ore in lumps of 6 in. in diameter and upwards. Sometimes pieces too large for one man to handle were encountered. The paint rock was in smaller chunks and so soft that it was broken by the dipper when it penetrated it. Great care was exercised in excluding foreign matter from cars, and for this reason it was often necessary to stop the shovel completely. The delays in getting rock out of the way generally followed a process called "clawing down." The ore was blasted and doubtless the natural solidity of the ore was affected by the blasting, but not to such an extent that the material would crumble and

fall down itself. To handle rock and foreign material, four 7-yd. cars were spotted at the shovel after each train was loaded. The next train coupled on these cars and they were handled as a part of the train as long as it was loading. The shovel and loading tracks were standard gage, laid with standard ties and 50- or 60-lb. rails. The shovel was moved forward on 6-ft. sections, but after it was moved 50 ft. a standard track was laid behind the shovel and connected with the loading track. This track became the loading track for the next cut. When the following study was made the mine was working apparently at full capacity. For blasting, holes were churned 16 to 20 ft. back from the edge of the bank. These were sprung with two to four 7/8-in. sticks of 60% dynamite and then loaded with about two kegs of black powder to each hole. No attempt was made to blow the bank down, the desire being to give the material a slight shaking. A typical cross-section is given herewith followed by observations given in the report:

Material, iron ore; type of shovel, 95 B; distance of move, 6 ft.; kind of teeth, rock; lift, 9 ft.; size of ties, 6x6 in. and 6x8 in. by 8 ft.; size of bucket, 2½ yd.; age of shovel, second season; shift, 10 hr., two shifts per day.

Coal was brought up in dump cars; plank laid from car to coal bunker, and coal carried across in boxes, each holding about a cubic foot. Water was taken from locomotive tender. Repairs were made on Sundays and as needed; complete overhauling in shop each season if needed. This shovel had never been in shop even for minor repairs.

Coal used, 2¾ to 3¼ tons per shift; oil used, 1½ gal. valve per shift, 1¼ gal. black and ½ lb. of grease; water used, 4000 to 6000 gal. per shift.

Kind of track, etc., 60-lb. standard rail; kind and size of cars used, steel ore cars of 100,000 lb. capacity, wood ore cars of 70,000 lb. capacity.

Train was braked by air; hand signals were used by man on ground; 60-ton standard locomotives used. Length of haul to mouth of pit, ½ mile.

Two trains, two locomotives. Locomotives alternated with trains to be loaded. Locomotive took full train in and brought back six empties; then stood on siding and waited until other train was out of way.

Weather, fair, warm and sunny.

Started work 1:20 and stopped work 6:30, making the total time covered 5 hr. 10 sec.

	Minutes	Seconds	Per Cent.
Actual working	173	30	57.9
Waiting for cars	71	5*	23.6
Moving shovel	9	40	3.2
Miscellaneous delays:			
Taking rock from car	4	40	1.6
Breaking rock	5	15	1.8
Breaking rock	18	50	6.2
Clawing down	1	10	0.4
Clawing down	2	45	0.9
Breaking rock	2	40	0.9
Picking rock from car	9	35	3.2
Clawing down	1	0	0.3
Total time under observation	300	10	100.0

* While waiting for the cars the shovel was idle 23 min. 5 sec. out of the 71 min. 5 sec., but spent the remaining 48 min. as follows:

Loading rock	25 min., 5 sec
Clawing down	5 min., 40 sec
Casting ahead	17 min., 15 sec

The cost of direct labor per day on standard basis was: Runner, $5; craneman, $3.60; fireman, $2.40; four pit men, $6; eight rockmen, $12; total, $29. During the observation there were 23½ cars of 50 tons and five of 35 tons loaded, a total of 1350 tons. Counting two tons per cu.yd., the total yardage was 675 cu.yd., this gives a cost for direct labor of 2.15c. per cu.yd. By a process of analysis this was distributed as follows: Charge to waiting for blasters, 0.225c.; to actual loading and delays moving up, 1.314c.; and charge to transportation 0.611c. The actual ratio of coal to water consumption was 6 to 7.7.

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Camp Bird Mine

The following data were taken from figures given in the annual report of the Camp Bird, Ltd., Ouray, Colo. The cost figures were taken from the profit and loss statement for year ended June 30, 1913:

OPERATING RESULTS FOR YEAR ENDED JUNE 30, 1913.

Receipts:	Per Ton Milled
By sale of bullion	$12.51
By sale of concentrates	9.84
From cyanide slags and matte	0.06
Miscellaneous receipts	0.05
Interest on bank balances	0.03
Total receipts from operating Camp Bird mine	$22.49

Expenditures:		Per Ton Milled
Mining:	Blocking out ore	$0.69
	Ore breaking	0.83
	Timbering	0.45
	Loading and tramming	0.72
	Hoisting	0.24
	Electric lighting	0.03
	Pumping	0.12
	Engineering, geology, etc.	0.03
	Mine sampling and assaying	0.04
	Foreman and shift bosses	0.29
	Power expense	0.57
	Maintenance	0.52
	Other mine expense	0.10
Total mining		$4.63
Tramway		$0.16
Stamp mill; labor, crushing, etc.		0.87
	Supplies and fuel	0.31
	Assaying and reporting	0.05
	Foreman	0.08
	Maintenance	0.31
Total stamp mill		$1.62
Cyanide mill; Labor		0.18
	Supplies and lights	0.49
	Assaying	0.04
	Foreman	0.12
	Maintenance	0.04
	Other cyanide expense	0.12
Total cyanide mill expense		$0.99
Shipping and selling expense		$2.78
General expenses including taxes		3.43
Depreciation on plant charged off		1.00
Total cost of production		$14.61

30,012 dry tons milled

During the year operations were reduced to a scale where ore could be furnished to but 25 stamps in the 60-stamp mill. Ore reserves were summed up as follows: Positive and partly developed ore, 23,000 dry tons that should yield a profit of $239,000; probable ore, 8000 dry tons that should yield a profit of $87,000. This estimate does not include any ore that may be developed below the 6th level.

Of the gold value in the crude ore there was a saving of 93.79%. Of the total value extracted there was obtained by amalgamation, 49.28%; concentration, 43.91%; cyanidation, 6.81%. Of the total contents extracted gold constituted 85.74%; silver, 9.92%; lead, 2.33%; copper, 2.01%. Gold content continued to decline.

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Refining Cost of Silver in Copper Bullion

It costs about 0.6c. per oz. to refine the silver obtained from copper bullion. As a consequence copper bullion carrying 150 oz. Ag per ton will cost 60c. per ton more to refine than a 50-oz. Ag per ton bullion, without considering any metal losses on the higher grade of bullion. This often explains a difference in refining tolls which otherwise seems inexplicable.

Carnotite—II.

By Thomas F. V. Curran*

SYNOPSIS—Carnotite mining is expensive, as the mineral is widely disseminated, no highly concentrated deposits being known. It is concentrated on the ground, and compounds finally made in Eastern or European laboratories. Special units are used to measure its radio activity.

Taken as a whole, it should be reiterated that the carnotite-ore resources are important commercially, but that they are extremely limited if measured by their capacity to produce say 150 tons per month of ore, averaging not less than 2% uranium oxide. At present four tons of what should be shipping ore is thrown on the dump for every ton of ore that is shipped. The average cost of mining and sacking 2000 lb. of carnotite ore is $32, and this does not take account of mine depreciation, as it certainly should be made to do. The sacks cost $3.50 and $4.50 per ton of ore, the wagon hauling, $20 per ton, the packing from many of the mines to wagon road costs $7.50 per ton, and the freight to Galveston from Placerville costs $9.50 per ton. If the ore is sampled in Denver, $1 additional should be added to freight charge, and $3.50 per ton for sampling charge. The freight to European ports is from $3.60 to $5 per ton. The usual price paid for this ore has been about $2 per pound U_3O_8, but when the presence of mesothorium seemed to frighten the radium makers in the early part of 1913, and the price of radium bromide dropped from $71 to $69 per mg., they began immediately to slash the price paid to the producers of carnotite, notwithstanding that they only then receive from the ore buyer about 8% of its contained value in radium, vanadium and uranium. Since then, the price of radium bromide has advanced tremendously, some quotations being $150 per mg., but, strange to say, the radium-makers seem to think there is now very little relation between the selling price of radium bromide and the price they wish to pay for carnotite. Nevertheless, they are dependent upon carnotite for their radium output.

The carnotite shipped from Paradox in 1911, aggregated 1515 tons containing 26 tons of uranium. In 1912, the output was 1092 tons containing 22 tons of uranium. The decrease was due partly to inactivity of two corporate operators during part of 1912, and also partly because many of the rich surface pockets of carnotite had been worked out and much exploration work was necessary. The output for 1913 will be about 1200 tons, containing about 25 tons uranium. If the mining is pushed energetically in 1914, the output should be about 2000 tons, containing 40 tons uranium, but the 1915 output would show a material falling off. In order to produce carnotite steadily and regularly, exploration and development work must be kept in advance of actual mining operations, and must be regarded as of prime importance. This must necessarily affect the price of the ore.

Vanadium has a multitude of uses, the chief one being as an alloy of iron, steel, copper and bronze, wherefore it is much in demand. Its effect in well deoxidized metal is: (1) About one-fifth of the alloy that is added to the metal, automatically scavenges the molten mass of nitride and oxide gases, which gases are "poisonous" and cause the minute holes from which rupture arises: (2) one-half of the remainder of the alloy unites with the carbonless portion of the metal called ferrite, and toughens it still more; and (3) the balance of the alloy acts upon the carbides, strengthens them, and distributes them evenly. Hence, vanadium-treated metals are uniform, close grained, tough and strong, and attain the maximum in economy, safety and endurance. The cost of reducing ordinary vanadium oxide to ferrovanadium is about 68c. per lb. of vanadium content. The market price of ferrovanadium is $2.50 per lb. of vanadium content.

In the form of sodium uranate, uranium is used for tinting glass, porcelain and ceramics. In rich coloring, the uranate addition is sometimes as much as 25% of the weight of the glass. Naturally, such glass is highly radioactive. The price of sodium uranate is from $2.70 to $3.50 per lb., according to its purity, or freedom from vanadium. Its reduction cost is about 90c. per pound.

E. de Haen, of Hanover, Germany, advertises ferrouranium at about $50 per lb., indicating limited use. A Sheffield steel maker, a few years ago, used a complex Portuguese ore containing uranium, in making steel for the British Admiralty. The static and dynamic properties were claimed to be so wonderful that the concern spent $60,000 in trying to produce another heat of uranium steel, but in vain.

Other Minerals Are Radio-Active

Carnotite and pitchblende are not the only minerals containing radium. Under the caption, "Uranium Ores in Portugal," the *Mining Journal*, London, says: "It has now, however, been proved that autunites (uranium ores from Guarda, Portugal), can successfully compete with pitchblende; that the known deposits of pitchblende are not sufficient to cope with the world's present demand for radium, even were all available ores placed on the market at once; that the most suitable ores for the extraction of radium are autunites; that the only known exploited deposits of autunites are in Portugal, and whatever the output, the increasing demand throughout the world for this mineral can never be supplied; that the average value of a 1% autunite ore is £30, or at $4.85, $145.50 per ton, and that there is practically a free market." Commenting, it may be observed that representative samples of this ore gave uranium values varying from 0.18 to 2.5%, with an average of 0.5%, and even this low average has been attacked by an autunite mine shareholder as too high.

Uranium Minerals Occur in Australia

The Australian carnotite is little more than an incrustation and powder on the faces, joints and crevices of a lode formation, which consists of magnetic titaniferous iron, magnetite, etc., and quartz in association with black mica (biotite). Practically all the secondary uranium minerals are encountered, such as:

Torbenite (copper-uranium phosphate)
Autunite (Calcium-uranium phosphate)
Uranophane (hydrous uranium-calcium silicate)
Carnotite (potassium-uranium vanadate)
Fergussonite (niobates of rare earths, uranium, etc.)
Gummite (hydrous oxide of uranium)
Uranium ochre, monazite, etc.

*Curran & Hudson, Placerville, Colo.

In the treatment of these ores, a preliminary leach of sodium-carbonate solution is recommended by Dr. Douglas Mawson, of the Australian Ministry of Mines, who is of the opinion that primary uranium minerals will be found in depth. The prominence given to the vugs lined with crystallized quartz, often amethystine or smoky, as the feature of the Mount Gee portion of the lode, recalls the characteristic feature of the Old Mexico group of claims in Bull Cañon, also the Sundown, Uranium Bell, and Bachelor group. Vugs filled with high-grade carnotite are frequently encountered in Long Park, but the lining is soft, almost decomposed and they are probably only old water courses. Little is known of the Turkestan carnotite; it is said to be low grade, not over 0.5% uranium-oxide content.

Rutherford and Soddy early suggested that radium is a disintegration product of one of the radio-active substances present in pitchblende, and from the fact that radium and uranium are always found together, that probably uranium is the primary source of radium. If so, the amount of radium in a mineral always should be in a constant ratio to the amount of uranium. This question was attacked experimentally by Boltwood, McCoy and Strutt, and the results obtained afford a direct and satisfactory proof that the amount of radium is directly proportional to the amount of uranium. The amount of radium per gram of uranium was found to be 3.4×10^{-7} gram. Consequently, one gram of radium element is present in a mineral containing 3000 kg. of uranium.

Electrical and Photographic-Plate Method of Determining Radiation

Two methods may be employed for examination of radiation of carnotite ore: (1) Photographic plate, and (2) ionizing action of the rays on surrounding gas, i.e., electroscope. The photographic method has been displaced by the electrical method, because it usually takes a day's exposure to darken the film appreciably and this darkening may be produced by rays not proceeding from the uranium constituent of the ore. Again, the thickness and rapidity of the films used affects the photographic effect of the different types of radiation. However, this method is valuable in investigating curvature of the path of the rays when deflected by a magnetic field.

The electrical method is a rapid and accurate means of quantitatively examining the radiation over wide range from extremely small intensity to very high intensity.

The extremely fine state of division of carnotite precludes successful ore dressing. Magnetic experiments have been unsuccessful. A method of sliming and subsequent attrition whereby the values, in the form of slimes, might be filter pressed or settled, lost one-third of the contained values. Crushing the ore and subsequent screening dry, gave negative results on works scale, although preliminary laboratory experiments gave promise of success. An elaboration of this method is to crush the ore coarsely and feed it through a revolving cylindrical-shaped copper brush, which removes the carnotite incrustation from the sand grains, without breaking the latter, then screening through a sieve having mesh too fine to permit the sand grains going through, thus separating the sand grains from the carnotite.

Alkaline Leach for Extraction

Leaching without agitation is impossible. Carbonate of sodium, rendering insoluble the lime present in the ore as sulphate, is advantageous. Nevertheless, freely formed calcium sulphate is a great hindrance to clarification of liquors and the free washing of the pulp. The action of the acid on the clay-like substances present, produces colloids, with disagreeable results. The clay present and the gases formed from the limestone form channels which are characterized by the colors left by the secondary precipitation along their course. No method depending upon difference in specific gravities may be employed. However, a Denver company is experimenting with low-grade carnotite ores trying to concentrate them by means of supposed difference in specific gravity of sand and carnotite, the separation to be effected by an air blast through a linen sheet covering an apparatus resembling a Wilfley concentrating table.

It is difficult to conceive of an ore more susceptible of chemical treatment than carnotite. In a solution of five parts water and one part c.p. sulphuric acid, 85% of the vanadium and uranium are in solution in 15 min., and the entire contents are in solution in 30 minutes.

The following is a method of alkaline leach. The ore is ground through a 14-mesh screen and boiled under agitation with a 10% solution of sodium carbonate until the values are in solution, as shown by the appearance of the pulp. This solution is yellow and contains the uranium as the soluble double carbonate and the vanadium as sodium vanadate (should there be a lower state of oxidation of either metal, as there probably will be, a preliminary oxidation would be necessary). From this solution, which is drained or filtered off, the uranium is precipitated with a solution of hydraulic acid as sodium uranate, which settles quickly and is filtered and dried. To the filtrate containing the vanadium, milk of lime is added, which precipitates the vanadium as calcium vanadate, and renders the sodium carbonate caustic, an equivalent of calcium carbonate being precipitated at the same time. The caustic solution, after filtration of the calcium vanadate, is recarbonated by the carbon dioxide from the preparation of the caustic lime and used over. This method has the advantage of using a reagent, which is indifferent to the action of carbonates of lime and iron and has also the advantage of producing a high-grade uranium concentrate.

Many Methods of Recovering Elements

In 1890, O. P. Fritchele, of Denver, produced 500 lb. of a compound of vanadium and uranium, by an electrolytic-chlorine method. Samples of this compound will be examined to ascertain if the radium values remain therein.

The Ohly process treats the carnotite with sulphuric acid and sodium carbonate in excess to precipitate iron and aluminum hydrates. The uranium and vanadium remain in solution in the excess of sodium carbonate. Ammonia is added to precipitate the hydrated oxide of uranium which is subsequently ignited to uranium oxide or sodium hydrate is added to produce sodium uranate. This method does not commend itself.

The general plan of concentration and marketing of carnotite, recommended by Prof. A. W. Forstall, S. J., Denver, in the 12th biennial report of the Bureau of Mines of Colorado, commends itself, namely, the preparation of sulphates consisting of the sulphates of barium, calcium, lead, with radium sulphates, or uranium and vanadium oxides with numerous impurities.

The U. S. Bureau of Mines, Denver, under direction of Dr. R. B. Moore and K. L. Kithil, has undertaken the problem of prevention of waste and of increased efficiency in carnotite mining; they are attacking the problem in a spirit of enthusiastic earnestness.

Carnotite residues, after acid treatment, may contain radium values in the form of insoluble sulphates. These are boiled with sodium carbonate solution, thus changing the values to carbonate, and after washing free from all sulphates, are leaching with hydrochloric acid. The mixed chlorides in solution are then purified to the desired degree of concentration, by fractional crystallization. The residues from the alkaline extraction return the barium and radium values as carbonates. After washing to free the residues from sulphates, they are extracted with hydrochloric acid, and the radium and barium precipitated as sulphates. Further concentration could be undertaken by reconversion into carbonates, washing, re-extraction as chlorides or bromides and fractional crystallization.

The absorption process of Erich Ebler (Heidelberg, Germany), aims to isolate or separate radium, polonium, ionium, etc., by absorption by colloids, such as threads of acetyl-cellulose, or of trisulfide of arsenic, silicic acid, which colloids are concentrated by volatilization or calcination. A very active preparation of radium was produced at the Neulenbach Radium Works, Germany, by a combined acid and alkaline fusion process which extracts the radium direct from the minerals in the form of a crude sulphate.

Radio-activity is the manifestation of the disintegration of the atom, a process that is spontaneous and constant. In radium, this disintegration is so intensely rapid that it may be observed easily and studied — witness the isolation and determination of the physical and chemical properties of the emitted gas, known as radium emanation, a product of the transformation of radium, while the continuous production from radium of the gas helium is added evidence in support of this theory.

The first commercial preparations of radium-bromide were produced by the Société Centrale de Produits Chimiques, 44 rue des Ecoles, Paris, under the direction of Debierne.

Doctor Giesel, chemist of the Chininfabrick, Braunsweig, Germany, first put preparations of nearly pure radium salt on the market. Rutherford notes: "Many scientific workers in this way obtained nearly pure radium bromide at a price initially of less than one-tenth of the prices today. The exceedingly high price of radium at the present day, £16, or about $79 per mg. of pure radium bromide bears no relation to the cost of separation from uranium minerals. The present price is artificial, and has resulted from the comparative rarity of deposits of pitchblende or uranium minerals containing fairly high percentages of uranium. The extensive use of radium for medical purposes as well as for physical and chemical experiments has so far absorbed the output."

In 1909, Lord Iveagh and Sir Ernest Cassel made a contract with the British Metalliferous Mines, Ltd., for 7½ grams of pure radium bromide to be supplied from the company's mines, near Grampound Road, Cornwall, at the price of about $20 per milligram.

The proper development of the American carnotite industry is dependent largely upon the establishment of a radium works in New York, Philadelphia, Baltimore or Denver, that will absorb the ore output of the independent carnotite-mine operators, at a reasonable price. There is little business risk in forming such a radium business, because radium extraction from the carnotite is being done profitably and regularly in Europe; the new Underwood tariff will lower greatly the price of chemicals used in the extraction process; the American use of one of these European radium-carnotite extraction processes may be acquired, together with experienced radium chemists to supervise works' operations. The use of radium is increasing rapidly in America, and physicians, surgeons and scientists, school and colleges are experimenting constantly to extend its use.

The committee for an international radium standard gives out the following units:

1 curie = quantity of radium emanation (0.60 cubic millimeter at 0 C. and 760 mm. pressure) in equilibrium with 1 gram of radium element.
This quantity gives a saturation current in an ionization chamber of indefinite dimensions, of 2.67 million electrostatic units (0.89 milliampere.) One curie of emanation per liter would equal a concentration of 2670 million mache units.
1 millicurie = quantity of radium emanation in equilibrium with 1 milligram (one thousandth of a gram) of radium element.
1 microcurie = quantity of radium emanation in equilibrium with 1 microgram (one millionth of a gram) of radium element. 1 microcurie per liter equals a concentration of about 2700 mache units.
1 milligram-minute = quantity of radium emanation produced in 1 minute by 1 milligram of pure anhydrous radium bromide. This quantiy is 0.073 microcurie and would give per liter a concentration of about 180 mache units.
1 electrostatic unit (e.s.u.) current measure = 3.33×10^{-10} (0.000000000333) ampere.
1 mache unit (m.u.) = saturation ionization current due to radium emanation from a liter of solution or gas expressed in electrostatic units multiplied by 1000.

Retarding Dissolution with Oxygen

In a 0.25% solution of KCN, the rate of solution of gold is increased by dilute electrolytic ozone, but is markedly decreased when the quantity is greater, 3 to 4%, says J. J. Andrejew, in *Zeit. f. Elektrochem,* 19, 1913, according to an abstract in "Journ. Soc. Chem. Ind.," Oct. 15, 1913. The cause of the decrease is the formation of a visible layer of oxide. A similar phenomenon is exhibited by hydrogen peroxide, although a large excess of peroxide, or a mixture of the two oxidizing agents, increases the rate of solution. This increased rate is accomplished by a decomposition of the oxidizing agent with evolution of oxygen. In more dilute cyanide solutions (0.01 to 0.05%) even atmospheric oxygen will produce the film of oxide and will cause the rate of solution to be much lower than it would be otherwise. In the case of silver, there is no reduction in the rate of solution, but a steady rise to a maximum as more hydrogen peroxide is added. Ozone alone has a very slight effect, but in combination with hydrogen peroxide it increases the effect of the latter.

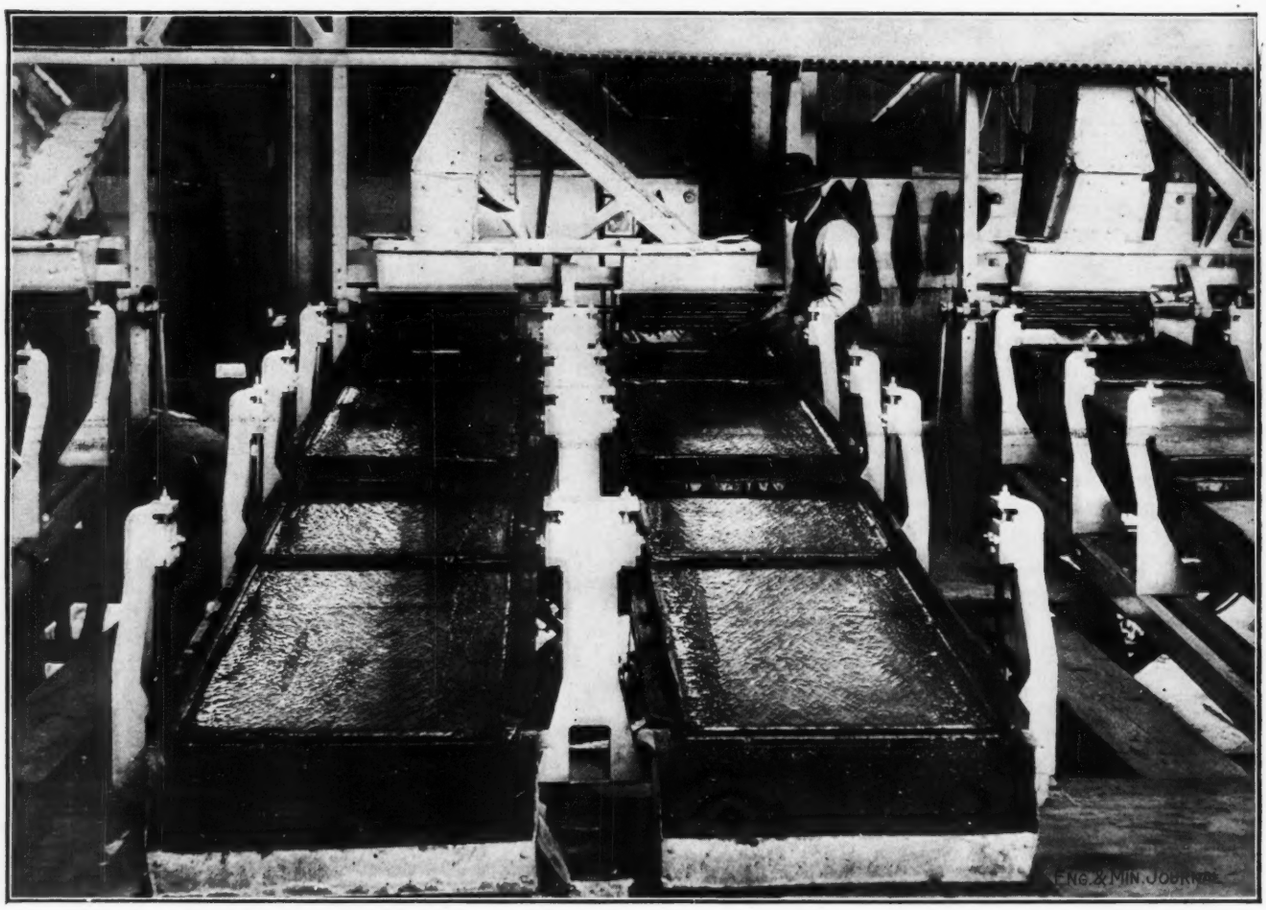
Mining in the Dominican Republic

Among the principal mines of the Dominican Republic now or formerly in exploitation are the Alto Velo phospate mine, the rock-salt mines, the chalk and talc mines, the Maimon del Cotui iron mines and other mines of silver, copper and sulphur ("Bull." Pan-American Union, November, 1913). The salt mines were worked by the natives before the coming of the Spaniards, and are said to be practically inexhaustible. Recently considerable activity has shown in mining circles in the Republic and a number of mines have been denounced.

PHOTOGRAPHS FROM THE FIELD

DEWHURST SLAG POT USED AT MT. MORGAN SMELTING WORKS, QUEENSLAND, AUSTRALIA

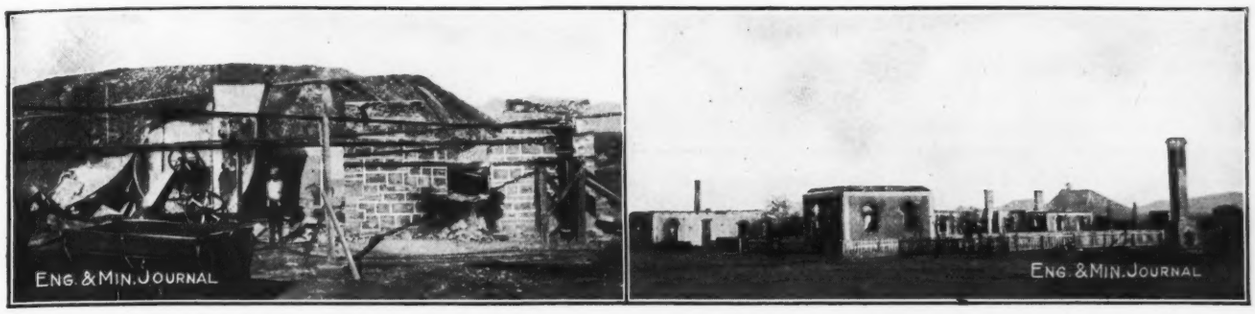
Pot shown is of 10 long tons capacity; one of 20 tons capacity is also used. Bowl is made in Sheffield, England, of particularly soft cast iron. The 20-ton bowl is cast in two pieces. Similar pots have been used at Cobar, N. S. W., for six years, yet show no signs of wear.



(Copyright by "London Daily Mirror.")

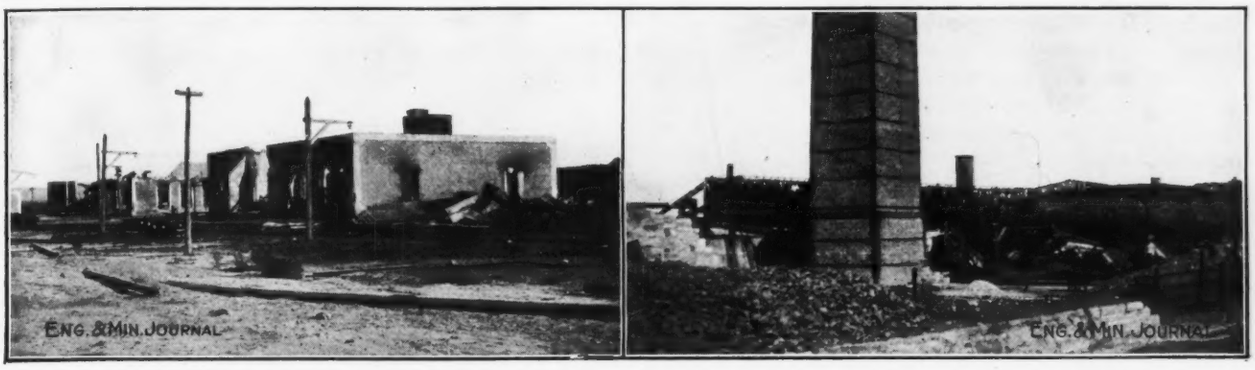
PULSATOR DIAMOND WASHER USED AT THE DE BEERS MINES AT KIMBERLEY, SOUTH AFRICA

To catch the diamonds grease is used on the tables which, in this illustration, somewhat resemble amalgamation plates.



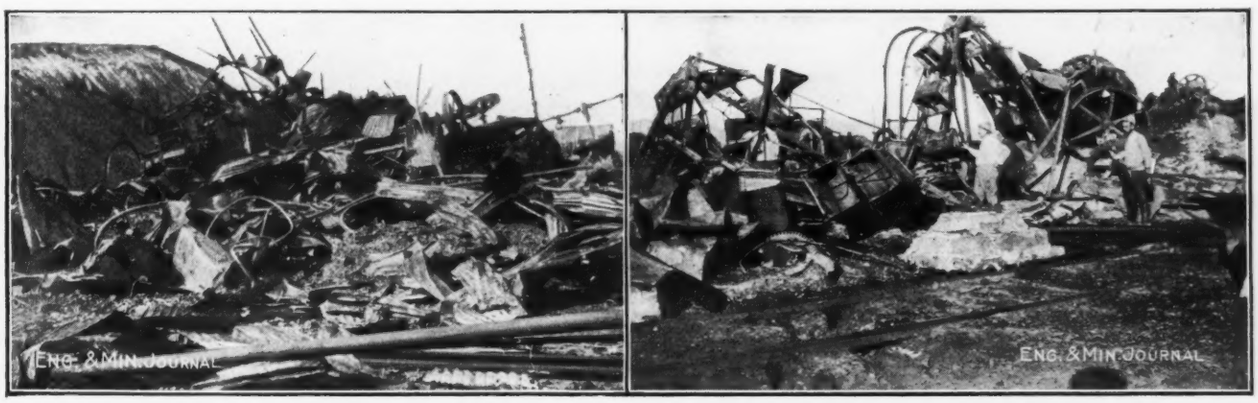
RUINS OF MINE NO. 2 FAN AND EMPLOYEES' HOUSES AT LAMPACITOS, MEXICO

The plant of the Cia. Carbonifera Agujita y Anexas, at Lampacitos, Coah., was destroyed by "Carranzistas," Aug. 16, and the Agujita plant on Sept. 27.



MACHINE SHOPS AT LAMPACITOS AND 100-FT. STEEL STACK THROWN DOWN BY THE REBELS

Washer, tipple, electric plant, shops, fans, hoists, principal buildings and 200 dwellings were destroyed.



RUINS OF THE AGUJITA WASHER

RUINS OF THE LAMPACITOS WASHER

Plants had a daily capacity of 1500 tons. At Agujita there was a Luhrig washer containing 16 Luhrig jigs, elevators, screens and a Stewart washer with two large jigs.

WASHER AT AGUJITA, SHOWING BRADFORD CLEANERS

ELECTRIC POWER PLANT AT LAMPACITOS

The entire plant of the Cia. Carbonifera del Norte at Menor was similarly destroyed Sept. 26, and the following day two mines and all equipment of the Cia. Carbonifera de Sabinas at Rosita were destroyed.

Wolf Locomobiles at Buckhorn Mine

By H. C. Cutler*

An interesting installation of prime movers furnishing power for mining and milling is now being made by the Buckhorn Mines Co. at Beowawe, Nev. The plant consists of two Wolf locomobiles of 350 hp. each, made by the R. Wolf company, of Magdeburg, Germany, direct connected to two alternating-current generators furnished by the General Electric Co.

The Buckhorn Mines Co., situated in Eureka County, Nevada, 30 miles south of Beowawe, and 16 miles west of the E. & P. R.R., controlled by George Wingfield, of Reno, after developing its property for the past five years, determined upon the erection of a 350-ton mill and cyanide plant. The question of power for this plant was serious. Internal-combustion engines, owing to their unreliability, and the expense of transporting oil 16 miles, were out of the question. The country in the mine's vicinity was devoid of wood for fuel, and after a careful consideration of all the questions involved, F. J. Siebert, consulting engineer for the Wingfield interests, decided on the erection of a steam-power plant at Beowawe on the Southern Pacific R.R., to generate electric power, and a 30-mile transmission line to carry this power to the mine and mill, thus doing away entirely with the transporting of fuel from the railroad.

Competitive bids were called for from all the manufacturers of prime movers, and after considering all the advantages and disadvantages of each and the economies attained the contract was awarded to the Trent Engineering Co., of Reno, American agents for the R. Wolf Co., for two compound-condensing superheated-steam locomobiles, VK XIII type, 350 hp. each under continuous maximum load with a guaranteed steam consumption of 10 lb. and fuel consumption of 1.2 lb. per b.hp.-hr. These locomobiles were to be fitted for direct coupling to two 225-kw. generators.

This installation, it is believed, will be the first of its kind in the United States although there are over 1,000,000 hp., in Wolf locomobiles alone, distributed throughout the different countries of the world, in over 6000 units.

These locomobiles have been used in Europe for a number of years with great success in all sizes from 20 hp. to 1000 hp., and show within these limits economies which compare favorably with the best class of turbines in large units. Within the past year they have been described thoroughly in a number of the American technical journals.[1]

Essentially, the locomobile is a combined boiler and engine. The boiler is of the locomotive type with removable tubes and a superheater, consisting of a number of pipe coils, in one end through which the waste gases at high temperature circulate. The engine is mounted on top of the boiler and is of the compound condensing type for superheated steam using the uniflow cylinder, which affords the greatest utilization of the high-pressure superheated steam and reduces the cylinder condensation to a minimum.

Frequent tests have shown a fuel consumption of from 0.8 to 1.2 lb. of coal (13,500 B.t.u.) and from 7 to 9 lb. of steam per b.hp.-hr. There are a number of advantages claimed for this class of engine over the ordinary kind. First, the combination of boiler and engine in one unit requires a minimum floor space for setting and only the slightest of foundations. No expensive or complicated brick setting for the boiler, and consequently smaller and cheaper engine-room buildings. Second, complete and simple supervision of the whole plant at once by one attendant. Third, great economies in fuel and steam consumption. Fourth, easy regulation and perfect reliability. Fifth, removable furnace tubes allow quick cleaning.

The results of the tests, which will be made in the plant at Beowawe as soon as completed and in good running order, are awaited with great interest by a number of the mining operators of Nevada and the Pacific coast who, on account of the high cost of the present electric power, are contemplating the erection of their own steam-power plants.

It is estimated that a power installation using the Wolf locomobile as the prime mover can effect a saving of from $1 to $4 per hp. per month over present prices. A complete description of the Buckhorn installation with pictures and results of tests will be given later.

*Mining engineer, Reno, Nevada.

[1]"Power," May 20, 1913; "Coal Age," Sept. 13, 1913; "Eng. and Min. Journ.," Nov. 15, 1913.

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Changes at Great Falls

Archer E. Wheeler has tendered his resignation as superintendent of the reduction department of the Anaconda Copper Mining Co., in Great Falls, to take the position of consulting engineer of the Union Minière du Haut Katanga. John H. Klepinger, now assistant superintendent of the smelter, succeeds Mr. Wheeler as superintendent, and Milo W. Krejci, metallurgist, becomes assistant superintendent. This is in line with the Anaconda policy of moving everybody up a step when there is a vacancy to be filled. James O'Grady will become manager of the plant, a new position created here by the Anaconda company. These changes were announced by C. W. Goodale, general manager, who said:

"A. E. Wheeler, superintendent of the Boston & Montana reduction department of the Anaconda Copper Mining Co., has tendered his resignation to accept the position of consulting engineer with the Union Minière du Haut Katanga, and his resignation takes effect Jan. 1.

"Mr. Wheeler came to the Boston & Montana works in September, 1895, after completing a course at the Massachusetts Institute of Technology, and from that date until 1901 he was in the engineering and construction department. In 1901 he was appointed assistant superintendent and in 1903 he succeeded John T. Morrow as superintendent.

"The directors of the Anaconda Copper Mining Co. have decided to make a change in the organization at the Boston & Montana works to the extent of having a local manager, the same as at Anaconda, and they have appointed James O'Grady to that position beginning Jan. 1. At the same time, J. H. Klepinger will be advanced to the position of superintendent. M. W. Krejci will take on some of Mr. Klepinger's present duties and will also, as in the past, give special attention to metallurgical operations and improvements."

Mr. Wheeler expects to leave Great Falls Dec. 26, and arrive in Brussels to report for his new position on Jan. 15. While he will have his headquarters in London and

Brussels, he will pass about half his time at the company's properties in Africa.

Mr. O'Grady, who will become local manager of the Boston & Montana works, came to Great Falls in 1893, and since then has been closely identified not only with the smelter, but with other large business and financial interests. Mr. Klepinger, who will be the new superintendent, has been with the works since 1899. Mr. Krejci, the new assistant superintendent, also came to the company in 1899.

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Aramayo Francke Mines, Ltd., Boliva

The Aramayo Francke Mines, Ltd., constitute one of the largest mining companies operating in the Republic of Bolivia. The principal industry of the company is mining tin, but among the other products obtained and marketed are bismuth and wolfram.

Recently the eighth annual meeting of the stockholders of the company was held in London, at which it was noted that the year's work showed a net profit of £153,177 for operations in Bolivia, without deducting charges in England. The previous year showed profits of £155,966 in the same way. The operations for 1913, however, have been more profitable, as the previous year's sales were largely out of the accumulated stocks, while in the last year the reverse is the case, a good stock of minerals having accumulated at the mines on account of temporarily reduced means of transport. Total sales of black tin amounted to only 3353 tons, as against 4053 tons for the previous year, the difference in price in favor of the latter year having been £7 14s. 8d. The sales of wolfram amounted to 281 tons, or £23,374, an advance over the work of the year before. In the sales of bismuth there was a small reduction, equivalent to 3698 tons, while the price was maintained unchanged. The total production of black tin amounted to 3694 tons, and that of wolfram, 109 tons; 33 tons of rich silver ore and 157 tons of copper, mostly unsold at the time of closing accounts, were produced.

The amount of ore treated in various mills of the company was 37,660 tons, 377 tons less than last year, due to the partial stoppage of Chocaya and Tasna. Average yield of the tin ore was 10%, and the main cost of production has remained practically the same as the previous year.

During the first five months of the present financial year, namely, June to October, inclusive, the production of black tin has been 72 tons less, and that of wolfram, 70 tons less, compared with the same period of the previous year, but it is expected that this deficiency will right itself before the end of the year. The production of bismuth has also been reduced by 13 tons in the same period, but this is due to a suspension of work at Quechisla in order to erect a fume-condensing plant to prevent loss by volatilization.

A tramway line 1800 m. in length has been built over the most precipitous side of the Chorolque mountain, and several switchbacks to connect these and other veins with the central station of the wire ropeway to free the Santa Barbara mill. Santa Elena, recently fitted with improved machinery, continues to work the dump with satisfactory results, and is now producing the cheapest tin. The Colon mine, in the northern part of the mountain, and the Eureka group of veins in the Yana-salli, have developed sufficiently to supply a greater quantity of ore than the Sala-sala mill can work, and a new plant is being sent to increase its capacity. The small mill of Cotani which, like Santa Elena, worked on tailings, continues to help with small production at low cost. The bismuth mines of Espiritu, in Santa Barbara, are gradually being opened up to provide ore to Quechisla, when the condensing plants have been completed. Wolfram has been neglected for the want of miners, and on the consideration that it can be procured cheaper and more abundantly at Chorolque, should the price compare favorably with that of tin.

The electric installation at Chocaya has been delayed by lack of labor, which accounts for the small production. This new installation is now working and the deepest pits and galleries of the mine are clear of water and exploration drives are opening up high-grade tin sulphides and rich silver ores under that section of the vein in which they were discovered at higher levels.

Additions to the concentration plant at Asllani are contemplated, and if these are added, it may be necessary to install roasting furnaces and lixiviation plant also, to treat the low-grade silver ores on the spot. In Quechisla, the smelting of bismuth from the mines of Espiritu will be resumed as soon as the condensation plant is completed, and the smelting of copper matte will be continuous as far as the available labor will permit.

Four dividends of 6d. per share have been paid, amounting in all to £59,659, and £10,000 of the debentures have been redeemed. Since the ending of the fiscal year, there have been paid two further dividends of 6d. per share, amounting to £29,829, and £30,000 more of debentures were redeemed on July 1 last. In addition, £20,000 was invested in securities as a reserve for disbursements in machinery, etc. After paying a bonus of 1s. 6d. per share, it is proposed to leave £36,000 standing to meet the increase of stocks of minerals, buildings, machinery, etc., and to provide for the possible redemption in July, 1914, of the £40,000 debentures outstanding, or part of them, at the discretion of the directors. Dividends for the fiscal year amounted to 17½% on the capital.

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Preparation of White Zirconium Oxide

The preparation of white zirconium oxide (iron-free) is covered in German pat. 262,009. Neutral or acid solutions of zirconium salts mixed with other salts are heated under pressure to a temperature higher than the boiling point of the solution at atmospheric pressure, and the precipitated zirconium oxide is separated from the impurities which remain in solution. Zirconium oxide obtained by hydrolysis from boiling solutions under atmospheric pressure cannot be easily filtered, but by heating to a higher temperature, under increased pressure, is converted into a product which can be readily separated by filtration.

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The Preliminary Work for the Extension of the Elizabethville-Kambove Ry., in the Congo, toward Bukama, is now being undertaken, and that 60 miles of the new line are expected to be completed by next March, says the "Engineer." The Lower Congo-Katanga Ry., which will be 1100 miles long, is now being surveyed, and on completion of the survey the construction work will be started. It is proposed to join the Cape to Cairo line at Bukama. The Congo-Tanganyika Ry. from Kabalo to the lake is approaching completion, and only about 60 miles, for which a portion of the grading has been finished, have now to be built.

CORRESPONDENCE AND DISCUSSION

Calculation of Extraction in Cyanidation

I see that Mr. Megraw, in his article in the JOURNAL of Sept. 6, 1913, takes exception to my note in the issue of June 21, 1913, more particularly in two instances: (1) His opinion is that a mortar-discharge sample is unsatisfactory when water is being used for crushing purposes. (2) When crushing is being done in solution, the cyanide so complicates matters that a correct sample is practically impossible.

With regard to the first point, I agree that it is necessary to sample a stream of pulp by taking all of the stream part of the time, as sampling by taking part of the stream all of the time is usually unsatisfactory, owing to the stream being by no means homogeneous. All of the stream from the mortar boxes at the Mijnbouw Maatschappij Ketahoen is sampled at certain stated regular intervals. The pulp-discharge from the lip of the mortar boxes extends over a width of about 3 ft. To take this sample, a shallow, $\frac{1}{16}$-in. iron trough is used, the dimensions being 4 ft. long by 3½ in. wide by 3¼ in. deep, rectangular in shape, having two handles fixed appropriately. This trough is inserted under the lip, and being longer than the width of the discharge, takes the whole of the flow. The sample is taken one battery at a time, being carefully transferred to the sample tin before the next battery is sampled.

The amalgamating tables at the M. M. Ketahoen are not directly in front of the mortar boxes, but in a room by themselves which is kept locked. Owing to this, there is extra space under the mortar-box lip to insert the sample trough, but should the amalgamating tables be fixed under the lips, the sample trough could be made shallower and wider, and the lips arranged so that no portion is lost. There is no absolute necessity that the apron plate be placed close to the lip, so in order that there should be no risk that the bottom of the sample trough become contaminated with amalgam, the end of the plate could be a few inches away from the mortar box. Of course, in getting a correct head sample with this system, there should be no inside amalgamation or amalgamated lip or splash plates in use. Very coarse gold, large enough to be caught and retained in the mortar box, would also make this sample useless, but Mr. Megraw himself remarks: "Few ores of milling grade have coarse gold in sufficient quantity to vitiate the general run of assay results." Further, "Moreover, consideration must be given to the mines, undoubtedly constituting the majority, which furnish their reduction plants with ores in which the value is not in coarse metallic form."

At the M. M. Ketahoen in 1911, by mill assay, 9599.9 oz. Au were sent to the cyanide plant, which received on its assay 9589.3 oz. In 1912, 7591.2 oz. were sent and 7566.4 oz. received. Taking the totals combined, 17,191.1 oz. Au left the battery and 17,155.7 arrived at the cyanide plant, a difference of only 36.4 oz., or 0.21%, and in my former note I have already remarked on the close agreement between the theoretical and actual extractions.

Although there is danger in hand sampling, from the unsatisfactory ideas of mill hands and other laborers, with regard to the necessity of care and accuracy in the operation of taking a sample, yet I think that Mr. Megraw's strictures are not altogether called for. The really capable amalgamator who is in charge of the battery during his 8-hr. shift is usually a conscientious individual who takes a pride and interest in his work, with often a healthy rivalry with the other shifts to get the best results. If the necessity for care in taking samples is explained to him, he will do the work in an intelligent way, either himself, or see that his feeder does it properly.

Taking the subject of crushing in solution, as water is used at M. M. Ketahoen, I can give no figures to prove my point here. I have, however, come across a paper by G. A. and H. S. Denny on "Rand Metallurgical Practice and Recent Innovations," read before the South African Association of Engineers in June, 1906, which entirely agrees with me in this respect. The paper describes the satisfactory working of the New Goch and Meyer & Charlton plants. This paper shows the possibilities of sampling a solution pulp and I recommend it to those interested in that kind of sampling.

The Messrs. Denny do not insist that the screen-assay valuation is a perfect method, but say that it seems to possess more of the elements of certainty and less those of uncertainty than any other practicable method known to them. They claim that the errors of a valuation arrived at from this screen sample, when the latter is intelligently and carefully taken, should be compensating over a period.

From a technical point of view, I should be only too pleased to have a sampling plant installed, as the more ways there are of getting at the head value of the ore, the better, but I doubt if the directors of any mines other than the largest would see their way clear to supply the necessary considerable financial aid for its installation. If close results can be obtained by simpler methods, the expense does not seem to be justified, and in a large number of producing mines, close results are obtained by these simpler methods.

To get a close agreement by the "head minus tail equal production" method of calculation, accuracy and care are essential and no doubt a certain amount of worry will ensue when something or other goes wrong. The ultimate result, however, leads to higher efficiency, not only in the man in charge, but also in the employees generally. The other method of "production plus tailing equals the head value" must in time lead to slackness even in the keenest of operators.

I note with pleasure that Mr. Megraw, in advocating actual sampling and correct extraction, uses practically identically the same arguments that I did in my former letter.

GEORGE SIMPSON, JR.

Benkoelen, Sumatra, Dec. 10, 1913.

EDITORIALS

Copper Precipitants

In the experimentation with hydrometallurgical methods of copper extraction, attention is largely concentrated upon the best way of precipitating the copper from solution. The obtaining of the solution and of a high percentage of the copper in it seems to be no great difficulty. The porphyry ores especially turn out to be small wasters of acid, not much going into solution except the copper and a little iron and alumina, wherefore the consumption of acid is small. Even so, however, the supply of acid is a matter of consideration, particularly in those cases where the ore is deficient in sulphur. The possession of an adequate quantity of sulphur is, of course, essential, whether the extraction of the copper is to be made directly with acid, or whether there is to be a reaction between a sulphate and a chloride and the final extraction of the copper as a chloride, which Mr. Laist does and which Mr. Bradley holds to be the right principle.

With regard to the precipitation, electrolysis and iron are the principal ideas. Cappelen-Smith, Van Arsdale, Canby, Channing and Field pin their faith to electrolysis; with insoluble anodes, of course. The acquirement of improved anodes, especially anodes of fused magnetite, and the introduction of sulphur dioxide into the electrolyte, reducing the electrical energy required, at but little expense otherwise, have put an entirely new and promising phase upon this kind of precipitation. Croasdale, Laist and Mathewson are exponents of the old idea of precipitation by means of metallic iron, in which the use of sponge iron reduced directly from iron ore obviates the old difficulty of insufficient supply of iron scrap and introduces advantages of its own. The exposition of this idea is perhaps due most to Croasdale and he seems to have been the first to use it in the experimental plant of the Calumet & Arizona, at Douglas.

The idea is neat. It consists in roasting pyrites, using the sulphur for the acid needed to extract the copper, mixing the burned pyrites with coal, reducing the iron, and using the iron to precipitate the copper from the sulphuric-acid solution. Of course, this presupposes the possession of a cheap supply of pyrites. Given that, there is nothing violating metallurgical precedent in the reduction of iron to sponge, without scorifying the gangue. It is well known that the reduction of iron oxides takes place at about 800-900° C. The difference between that temperature and 1300° C., or so, represents the saving of fuel, plant, etc., by not having to scorify the gangue and fuse everything. Such an iron reduction always occurs in the zinc smelting retort and iron so produced has in Europe been commercially picked out of the retort residues by magnets. Several inventors have proposed to concentrate low-grade iron ores in just that way, the Jones step process being of this nature, and certain so called metallizing processes.

Mr. Croasdale thinks that the preparation of sponge-iron precipitant can be arranged as a simple, foolproof process, and that the cost need not be more than $6 per ton of iron and perhaps much less, not figuring any cost for the ore, even in such parts of the country as Arizona. This sponge iron is an ideal precipitant, offering a large surface and acting very quickly. We fancy that the best results will be obtained when nearly pure pyrites be available. Any gangue will, of course, settle with the copper precipitate. If lower-grade pyrites be the only thing available, it will, of course, be a matter of balancing whether a preliminary separation of the gangue by magnetic separation, or otherwise, or a subsequent slagging of the gangue be the cheaper.

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Foreign Steel and the Tariff

The imports of iron and steel in October, the first month under the new tariff, do not show any change of importance and do not furnish any indication of an increased pressure of foreign material. There are no signs that any quantities of iron or steel were held in bond—as was the case with some other articles—waiting for the lower duties to take effect. The total value of the imports for the month is given by the returns of the Department of Commerce at $2,574,978. This is a little—$146,137—below the total for September, but it is $198,938 less than in October of last year, and it is $254,158 below the average of the 10 months of the current year. In short it was about an average month, showing no more than the usual fluctuations of trade, and is very far from pointing the way to any flood of foreign material, either immediately or in the future.

It must be remembered that the reduction in duties comes at a time when business in England and Germany is falling off from the active conditions which prevailed earlier in the year, and when steel makers there might be supposed to be on the watch for any opportunity to place their goods abroad. They seem to have regarded this country as a unpromising field, or at any rate as one to be approached only with caution. For the greater part of the current year foreign prices of finished steel have been as high as our own in most lines—higher in a few. Even with the depression of September and October, there are few marked differences in level. In most cases the ocean freight is quite sufficient to balance any differences.

It is true that offers of material have been made here by foreign agents, but they have been for the most part only tentative and have not been attractive or pressing enough to develop any business. The only place where business has been at all pressed has been on the Pacific Coast, where opportunity was offered by the relatively high prices due to the high rail rates from Eastern mills. That the offers of German bars and shapes there have been met by prompt reductions on domestic material may be taken an an indication of the probable course of trade. In any case, foreign offers are likely to be limited to this Pacific Coast business or at the most to the immediate seaboard in the East, rail rates preventing any serious competition at interior points.

In short, the lower tariff rates do not promise to have any important effect, so far as the volume of imports is concerned. They may, however, have a considerable effect on prices. Any rapid advances, such as occurred in the boom of 1906-7, will be checked by the knowledge that foreign makers are ready to step in when there is a chance for profit. It may be that our makers will have to keep prices at a lower level, except in those exceptional times when all the iron-making world is busy at once—too busy to be seeking trade abroad. And those times do not come too often. A lower range of prices we may look for, but not for any great quantity of foreign steel.

Strike Lossess

Few things are more difficult to estimate closely than the actual losses caused by a strike at a mine. Extravagant sums are frequently named, and it is seldom that the amount of the losses is anything more than a wild guess, too apt to be influenced or to vary according to the writer's view of the stock market. Our attention has been called to this point by a statement in a contemporary purporting to give the losses resulting from the miners' strike in the Lake Superior copper country. This not only allows for the loss in wages of the men, for the necessary care of the mining properties, and other legitimate charges, but includes the amount by which copper sales have fallen off during the strike. This last is wholly unreasonable. The receipts of the companies have been less, of course, but the copper has not disappeared. It is still in the mines and will be taken out and sold in due course, when the strike is over. This case, however, is almost too absurd to call for comment were it not for the frequency with which similar statements are put forth.

In this connection it is a rather curious fact that the interruption of mine production by strikes seldom seems to cause any special inconvenience to consumers or to make any serious disturbance in the market. It is only when labor trouble is general or much prolonged—as in the anthracite strike of 1902—that results are at all serious. In the case of the copper strike prices have receded instead of advancing. Of course, it happened that this strike coincided in time with decreasing consumption and lower demand for the metal. There are scores of other cases, however, in which the results have been very much the same; and this opens the way to some curious speculations which space prevents us from following up at the present time.

The New York Workmen's Compensation Law

The legislature of New York has lately enacted a workmen's compensation law, the Empire State thus joining the enlightened movement which has obtained so extensively among other states. The enactment of legislation of this kind is not socialism, but is merely equity, and employers might as well make up their minds to it. The occupational destruction of life and impairment of health has to be paid for by somebody or by society in general. Heretofore, the burden has been borne by society, but the present theory is that it is properly a charge upon the respective industries, and there ought not to be disagreement respecting that idea.

The New York law seems to be effective and generous, yet fair all around. The payments to disabled employees and to widows and orphans are liberal. On the other hand, employers are given considerable latitude as to ways of financing the funds to meet obligations under the law. The law is limited to a list of regularly conducted industries, and the person who employs a man occasionally, to do some odd jobs around his house, etc., is exempted. All of this is, of course, quite rational.

This enactment of workmen's compensation legislation is having the effect of increasing attention among industrial managers to the prevention of accidents. There is no question at the present time that is being more earnestly considered by them. This also is just as it should be. An Irishman would probably say that the cheapest way to pay for accidents is not to have them.

Lead and Spelter as Competitors

Changes in the relative prices of the common metals are apt to produce interesting results in the way of one displacing another. Thus aluminum may be bought for electrical transmission wire when it is cheap and copper is dear. A high price for tin increases the use of lead in coating sheet steel. So with other things.

A curious development occurred in Europe this year when the price of lead rose above the price for spelter, and caused certain users of sheet lead to switch to sheet zinc, there being some purposes for which the latter would do just as well, or at least it was so thought. It is said that coffin manufacturers took 30,000 tons of sheet zinc for the lining of funeral caskets instead of lead ordinarily employed.

It will be recollected that in this country antimonial lead used to be largely employed for that purpose, this being when it sold at a discount from the price of soft lead. That was all changed, however, when antimonial lead came to sell at its alloy value.

The commanding position of the United States in the copper market is well illustrated by the drawing by our refiners of supplies from all parts of the world. They get crude copper from Alaska, Australia, South America, Africa and in considerable quantity from Europe itself. Copper from Spain has been coming to us for many years. This year we have been getting the output of Servia. During 1913 also some of the Katanga copper has come to us. The steady increase of our copper-refining capacity enables our refiners to reach out for this business, or perhaps we should say that it is their ability to secure it that leads them to increase their capacity.

The supply of crude copper to American refiners, as reported by the smelters, showed a remarkable drop in October as compared with September. In September, the total was a little over 138,000,000 lb.; in October, it was only 115,000,000 lb. This is accounted for by a decrease of about 3,600,000 lb. in the output of American mines, and a decrease of about 19,400,000 lb. in the supply coming from foreign countries. The receipts from Mexico, where things have been coming to a crisis, fell off a good deal and there were also decreases from elsewhere. The Michigan production did not change much from September to October. Anyway, the October supply of crude copper was the smallest for any month of 1913.

BY THE WAY

Conservation of natural resources is defined by the *Buffalo Express* as "talking forever about water power and coal mines, and never using them." In short, conservation is identically equal to conversation.

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The U. S. Civil Service Commission announces an examination for laboratory assistant, for men only, on Jan. 21 and 22, 1914, to fill positions in the Bureau of Standards, at salaries from $900 to $1200 per year. Persons desiring this examination should at once apply for application Form 1312, Laboratory Assistant, male, No. 40—Amended, to the U. S. Civil Service Commission, Washington, D. C.

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Timber is becoming increasingly scarce on the iron ranges. While most of it is lost by breakage and goes into the "mat," rotting is also responsible for a considerable consumption. One company conceived the idea of creosoting those timbers which looked as if they would rot before they broke. Accordingly some pieces were dipped in creosote for an experiment and sent down to one of the stations where they were piled to await distribution. The captain came along on his rounds and sat down on the pile to take five and have a smoke. Now creosote, as a corrosive, is second to few. The captain lost much cloth and large areas of skin from strategic points. This put the kibosh on creosoting timbers at that mine.

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According to an excitable contemporary, rock is being mined in Kilo, Belgian Congo, from reefs which run 60 to 70% gold. (The compositor did not make an error there, per cent. was intended.) "They treat the white miners well, pay £40 per month with board, wines and liquors free. An Australian said he had more champagne than he could use. The Belgians are making a road from Kilo to connect with the English road from Ginga, on the Great Nyanza. There is no doubt the Rand will have to take a back seat, for Kilo is the premier goldfield of the world. Until the Ginga-Kilo road is completed it would be impossible to get a mortar box into the country." Some of this sounds exaggerated, but the last statement we fully believe. Someone else take a try at the rest.

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A certain mine decided to change its two-stage pumping system to a single lift to surface. The head was terrific, about 2200 ft. A pump was built and installed, but the manufacturer was sceptical as to whether valves could be made to stand up. It developed that they could not; they broke their seats steadily and disastrously. Many mechanical engineers were called into consultation, 13 or 15, it is said, who experimented and figured and analyzed the mine water and tried about every hard alloy known to science, most of the brasses and bronzes and a large number of more complex mixtures, but not one of them was hard enough and tough enough to stand up. The valves continued their merry breaking. When the last alloy had gone to pieces, the big Swede pumpman who had watched all the experiments modestly and patiently judged it to be his play. "By yiminy, Ay feex heam." So he got a hide, the best leather, and he put leather facings on all those valves. The first set lasted 14 months.

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Most mines live in more or less dread of fire. On the iron ranges, where the caving system is followed and work is carried on under a mat of dry timber that may be several hundred feet thick, fire is a thing to be spoken of in whispers. Several have occurred, mostly small and nonfatal. At one mine a shift boss wanted to see how much ore there was in a chute. So he lighted a paper, rather a large one, and let it float down the chute. This is rather a common trick. When the paper reached the top of the ore, the shift boss saw how much ore there was and also saw the fire catch the sides of the chute. He was only a little way from a working place, and a car or two of material would have put an end to the life of that little fire. But this shift boss was ossicephalous; he first ran back to the shaft and down the ladderway, hunting for the captain; failing to find him, he ran in to the mouth of the chute and drew out all the ore. The chute was a roaring chimney in a minute. It took a long fight, attended with considerable risk to get it out. The mine now has a chemical engine hauled by an electric locomotive, many fire helmets, extinguishers at important points and "fire bugs," who make the rounds continually, putting out small blazes, removing and reporting dangerous conditions and keeping a watchful eye on shift bosses.

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The workers of metals are among the most conservative of artisans. It is only within a decade or so that the chemist has found any place in the brass mills, wire mills, sheet mills, etc., and even now many plants are run by rule-of-thumb methods and with procedures resembling the incantations of alchemists of old. The brand on the bottom of an ingot or slab of metal is the all-important thing, the governing factor. Of course, molds may be shifted from one smelting works to another, especially when several belong to the same company, and the trick has in fact been played, but the casting-room foreman does not know about such conditions, and so long as he recognizes the well known brand, everything apparently is all right. There was not long ago a certain manufacturer of castings who always specified an unusual, but little made and distinctly inferior brand of copper, which we will call the "AA." On its merits, this copper was worth about ¼c. per lb. less than electrolytic, but the founder in question paid cheerfully for it a premium of ¼c. per lb. above the price of electrolytic. The broker who sold him this copper once inquired of him why he was so determined to have it, why he would not take a better copper at a lower price. "Well," said the manufacturer, "I've got an old foreman who spoils every casting that he tries with any other kind of copper. So it's a question either of using AA copper or getting a new foreman. The old man has been with me many years, and except in the matter of copper, has been running things economically. I make money and am satisfied, and so I have made up my mind to keep the old man. Also, I shall keep on buying AA copper."

PERSONALS

Prof. A. L. Walker, who is down with typhoid fever, is improving slowly.

M. H. Kuryla, Mexican representative of the Merrill Metallurgical Co., of San Francisco, is in New York.

G. B. Lantz, of San Francisco, has gone to Manila to take a position with the Colorado Mining Co. in the Philippines.

Ralph Arnold was in New York last week on his return from Venezuela.

H. C. Hoover, who arrived from London last Saturday, spent this week in New York and then proceeded to San Francisco, where he will remain for several months.

Robert C. Sticht, general manager of the Mount Lyell Mining & Ry. Co., Tasmania, will start in January on a tour of the world.

W. A. Farish, Jr., has taken an interest in the firm of Miller & Brown, chemists and metallurgists, San Francisco, in place of M. Brown, who retires. The Miller-Farish Co. is the style of the new firm.

Professor H. H. Stoek, of the department of mining engineering of the University of Illinois, has returned to Urbana, Ill., from a trip through the East, where he attended several important meetings.

H. V. Winchell has been visiting Butte. He intended to go from there to Cripple Creek, but owing to the recent heavy snowfall in Colorado, which prevented the examinations that he had planned, he postponed his trip to Cripple Creek and returned to Minneapolis.

George J. Siedler has resigned as sales manager of the Taylor-Wharton Iron & Steel Co., of High Bridge, N. J., to become vice-president of the Eynon-Evans Manufacturing Co., of Philadelphia, on Jan. 1, 1914. W. S. Stothoff succeeds Mr. Siedler.

OBITUARY

Frederick Potter Thorpe died in New York, Dec. 21, aged 45 years. He was born in Michigan, but had lived in New York for several years. He was a consulting engineer and representative of the Power & Mining Machinery Co. He was a member of the American Society of Mechanical Engineers.

Captain John H. Taylor, who was for a number of years one of the prominent mining men of the Lake Superior district, died at his home at Fond du Lac, Wis., on Dec. 7. He was born in the County Londonderry, Ireland, in 1830, and came to this country in 1846. He remained in Massachusetts until 1861, when he went to the copper district of Michigan, where he began his mining career. His first work was at the Quincy, going later to the Elroy, which was shut down in 1869. In that year he journeyed to Ishpeming and was in charge of the old New York mine until 1872. The following few years were spent in mining camps in the West, then the returned to Michigan to take charge of the Commonwealth property. Later he served as manager of the Great Western mine at Crystal Falls and then went to the Gogebic range, where mining work was just being started, arriving there in 1885. He sunk the first shaft at Ironwood and mined the first ore that was shipped. He was in charge of the Ashland and Germania properties until 1894, when he retired from active life. He spent a great many years at mining work and was considered one of the best iron men in the Lake Superior country. The funeral took place at Fond du Lac under the auspices of the Masonic and Knights Templar orders.

C. P. Sandberg, for many years a high authority on steel manufacture, died in London, Dec. 10, aged 81 years. He was born and educated in Sweden, but went to England since 1860, as inspector of rails for the Swedish government. After some years in England in this capacity he began to practice as consulting and inspecting engineer, and his work in connection with rails and permanent way generally soon secured for him an international reputation. He became a member of the Institution of Civil Engineers in 1866, and two years later was awarded the Telford gold medal and a premium for his paper on "The Manufacture and Wear of Rails." His sections of rails known as the Sandberg sections were first introduced in 1878, but a later design was brought out in 1894. They were soon in demand, and some millions of tons have been made. More recently he introduced what became known as Sandberg silicon steel rails, which are also widely used, and in 1907 presented a note on the subject, entitled "The Chemical Composition of Steel Rails and Latest Developments," for discussion at the engineering conference of the Institution of Civil Engineers. From the beginning of railways in China Mr. Sandberg was connected with most of those built under British auspices in the capacity of consulting and inspecting engineer, and more recently he had occupied a similar position for the Government of Siam. In addition to the Institution of Civil Engineers, Mr. Sandberg was a member of the Iron and Steel Institute, the Institution of Mechanical Engineers, the French Institution of Engineers, and other technical societies. He was also the author of many papers dealing especially with rails, and for his expert services received decorations from Sweden, Belgium, Russia and China.

SOCIETIES

New Mexico School of Mines—This school is preparing cabinets containing specimens of practically all the minerals found in New Mexico, to be given to various educational institutions throughout the state.

Old Freibergers in London—The Old Freibergers' Society held their semi-annual dinner on Dec. 4 at the Imperial Restaurant, Regent St., London, England. Sixteen members and one guest were present. Edward Hooper, the president, occupied the chair. The evening was enlivened by the singing of old German Kommerslieder, and was thoroughly enjoyed by all those fortunate enough to be present.

Mining and Metallurgical Society—The New York Section met at the Engineers Club, Dec. 18, with an attendance of about 40 members. The subject of discussion was "The One-Man Drill." The principal speakers were Messrs. Catlin, Devereux, Saunders and Munroe, but there was general participation in the discussion, which was interesting, instructive and lively.

NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ELECTRIC RETORT FURNACE. Jean Bally, Grenoble, France. (U. S. No. 1,079,588; Nov. 25, 1913.)

ORE REDUCING PROCESS. James A. McLarty, Toronto, Ont. (U. S. No. 1,079,788; Nov. 25, 1913.)

ROASTING—A Method and Apparatus for Treating Ores, More Especially Applicable for Roasting Spent or Burned Pyrites and the Like. E. R. Sutcliffe, Lancashire, Eng. (Brit. No. 16,450 of 1912.)

ROASTING—Improvements in Ore Roasting or Drying Furnaces. H. M. Ridge, London, Eng. (Brit. No. 23,763 of 1912.)

ROASTING FURNACE. Edward J. Fowler, Redwood City, Calif., assignor to Pacific Foundry Co., San Francisco, Calif. (U. S. No. 1,079,405; Nov. 25, 1913.)

CONVERTER PROCESS. Otto Thiel, Landstuhl, Germany. (U. S. No. 1,080,606; Dec. 9, 1913.)

DEPHOSPHORIZING PIG IRON, Improved Process for. A. Francois, Dijon, France. (Brit. No. 25,251 of 1912.)

ELECTRICAL REDUCTION FURNACE. Royal E. Frickey, Heroult, Calif., assignor to Noble Electric Steel Co., San Francisco, Calif. U. S. No. 1,080,824; Dec. 9, 1913.)

NODULIZING—Mechanism for Nodulizing Materials. Lewis P. Ross, Standish, N. Y., assignor of one-half to Northern Iron Co. (U. S. No. 1,081,063; Dec. 9, 1913.)

ROASTING—An Improved Process for Roasting Carbonated Iron Ores. J. Sovignet, Paris, France. (Brit. No. 145 of 1913.)

SPOUT FOR STEEL FURNACES. Charles E. Michaels, Wilson, Penn. (U. S. No. 1,080,071; Dec. 2, 1913.)

ALUMINUM ALLOY. Walter Northcote Naylor, Forest Hill, London, and Stanley Page Hutton, Beckenham, England. (U. S. Nos. 1,080,155 and 1,080,156; Dec. 2, 1913.)

DRILL—Percussive Tool. Lewis C. Bayles, Easton, Penn., assignor to Ingersoll-Rand Co., New York, N. Y. (U. S. No. 1,080,095 and 1,080,096; Dec. 2, 1913.)

MINE-CAR LUBRICATOR. Joseph Henry Thomas, Independence, Colo. (U. S. No. 1,080,500; Dec. 2, 1913.)

MINER'S LAMP. Charles Dushek, Beloit, Wis. (U. S. No. 1,080,050; Dec. 2, 1913.)

CONCENTRATOR. John S. Finlay, Wallace, Idaho. (U. S. No. 1,080,053; Dec. 2, 1913.)

CONCENTRATOR—Centrifugal Ore Concentrator. Edward C. Latchem and Lewis W. Pollock, Oakland, Calif. (U. S. No. 1,080,223; Dec. 2, 1913.)

ORE SEPARATION—Centrifugal Ore Separation. A. Habermann, Radderrupfelt Mine near Alston, Cumberland. (Brit. No. 7647 of 1913.)

EDITORIAL CORRESPONDENCE

SAN FRANCISCO—Dec. 16

The Western Fuel Co. Cases proceeded to the taking of evidence, Dec. 15, the complete jury having been secured Dec. 12. The jury is composed of two butchers, two hardware merchants, one insurance solicitor, one promoter, one banker, one millwright, one apartment house proprietor, one musician, one blacksmith, one paint merchant. U. S. Judge Dooling states that the trial will proceed five days a week and four hours a day until finished.

A Plant on Searles Lake potash lands may be installed next year; the prospects of such a development are favorable. The construction of the railroad from Searles on the Southern Pacific to the property of the American Trona Corporation is under way and plans for the building of an operating plant are under consideration. In the last year there was much litigation and many obstacles had to be overcome before the corporation felt safe in undertaking the installation of a plant, or the building of the necessary railroad. The railroad is to be 31 miles long, and is as essential to the profitable commercial handling of the potash as the installation of a plant is essential to the economic production of potash. The initial plant is said to be planned for handling 50,000 tons per year, and the capacity is to be increased as the demand requires.

Completion of Yuba No. 14 all-steel dredge on Dec. 16, ready for actual digging on Dec. 17, established the best time-record ever made in all-steel dredge construction in North America, and so far as known in the world. The elapsed time, beginning with the date of driving the first rivets on the hull, Aug. 13, was four months and four days. This is the largest dredge for digging placer ground ever built. The general dimensions are: Hull, 155 ft. 6 in. long, 58 ft. beam, 5 ft. overhang on each side, 11 ft. 6 in. deep; well hole, 8 ft. 3½ in. wide in the clear; digging ladder, 134 ft. long between centers; stacking ladder, 136 ft. long between centers; spuds, 62 ft. long and weighing 82,000 lb. each. The buckets are 16-cu.ft. capacity. The three other all-steel dredges built in California are Natomas No. 10, No. 8 and No. 7. The first new all-steel boat, No. 10, is equipped with 15-cu.ft. buckets and was built in five months, 21 days; No. 8, a reconstructed 15-cu.ft. dredge, was completed in four months, 4 days; No. 7, a reconstructed 9-cu.ft. dredge, was completed in four months, 28 days. Besides being the largest all-steel dredge in North America, Yuba No. 14 is the only dredge provided with a steel deck, the building of which required 15 more days than a wooden deck would require. The dredge is absolutely fireproof. Even the gold-saving tables are entirely of steel, except the wooden parts of the cleats. The floor of the winch room is built of wood, and that is the only portion of the construction containing any amount of wood worth notice. The dredge was designed and built by the Yuba Construction Co. at the Marysville shops. The dredge is two miles north of Hamilton on the east side of Yuba River, in Yuba County.

DENVER—Dec. 19

An Explosion at the Vulcan Colliery of the Rocky Mountain Fuel Co., at Newcastle, on Dec. 16, killed 38 of the 40 men employed. The flame of a miner's candle igniting a pocket of gas was given as the cause among the miners, as the mine is known to be a gaseous one. Newcastle was the scene of the first big coal-mine disaster in Colorado in 1889 at the Santa Fé mine when an explosion similar to the one at the Vulcan killed 75 miners.

Nothing new in the Strike Situation has developed. At the state labor convention now being held at Denver it is said that 500 delegates representing 275 crafts and 60 unions are present. The delegation from the south is instructed for a state-wide sympathetic strike, and the question is being warmly debated. A resolution has been introduced and adopted, urging the sending of a telegram to Colorado's delegation in Congress urging them to ask Congress for an investigation of the strike. If a sympathetic strike of all crafts is decided on, action will be taken in such a manner that it must be ratified by a referendum vote of all unionists in the state before becoming effective. Adjutant-General Chase has announced that all militia in the southern coal fields, with the exception of 200 to 250 cavalrymen armed with carbines and side arms, will be recalled from the southern coal-field strike district in the near future unless action for a state-wide strike of union labor crafts is ordered by the convention now being held in Denver. On the other hand, should the state-wide strike be called the troops now in the southern fields will be reinforced and every militiaman released on furlough or indefinite leave of absence will be called to arms again and held in readiness to quell any disturbances which may threaten. With the arrival here Dec. 16 of J. P. White, presidentdent, and William Green, secretary-treasurer, from Indianapolis, the United Mine Workers took preliminary steps toward bringing individual damage suits for $50,000 each against the state of Colorado and individual militia officers, who, the strikers say, have been guilty of illegal acts in the coal fields.

SALT LAKE CITY—Dec. 17

Utah Men Are Interested in Wyoming Oil Lands. Three tracts, aggregating 1400 acres, have recently been taken over. One of these is near Casper, where two companies are pumping 15,000 bbl. daily. The land obtained by the local company has been withdrawn from entry, and a royalty of 10% must be paid to the state. The oil is of good quality, and a great deal of it produced at present is shipped to Salt Lake for refining. Among Salt Lakers interested in the new development work are John Dern, Lafayette Hanchett, W. H. Dickson, Duncan MacVichie and others.

Twenty-three Utah Mines Paid Dividends aggregating $7,569,904 during the present year. These are: Bingham-New Haven, Centennial-Eureka, Chief Consolidated, Cliff, Consolidated Mercur, Daly-West, Daly-Judge, Eagle & Blue Bell, Grand Central, Gold Chain, Gemini, Gethin Le Roy, Iron Blossom, Ingot Gold, Moscow, May Day, Mammoth, Opohongo, Silver King Consolidated, Silver King Coalition, Utah Copper, Utah Consolidated, and Yankee Consolidated. Beside these dividends were paid by the three large smelting companies operating in this state, a good proportion of whose revenue is obtained from Utah ores. The dividends above mentioned do not include profits from the United States company's mines at Bingham. Five new dividend payers appeared during the year: Chief Consolidated, Eagle & Blue Bell, Gethin Le Roy, Silver King Consolidated, and Ingot Gold. The total of dividends paid by the 23 mining companies amounts to $66,210,167.

CALUMET—Dec. 19

Freedom from Disturbances has been enjoyed for the last week. The strikers have discontinued their early morning parades, and have not held any demonstrations. The sheriff of Houghton County has notified the federation that men working are not to be interfered with in any way, and he is backed up in his position by several thousand citizens of Houghton County, who stand ready at any time to answer to the call for assistance. The situation is well in hand and there will be no more utter disregard for law and order that has prevailed throughout the district since the beginning of the strike. The last week was the first since the beginning of the trouble that men going and coming from work were not intimidated, threatened and insulted, and that the people of the community have felt secure in their homes. The civil authorities have been searching the district for firearms and have secured several rifles, shotguns and revolvers in the houses of the strikers and other places in the strike zone. In Keweenaw County the sheriff is recruiting a force of mounted police, which will be comprised mostly of former military men who were in service in that county. The grand jury is in session in Houghton and a thorough investigation is being made into the crimes that have been committed. Several witnesses have been subpoenaed to appear, among the number being Charles H. Moyer, president of the Western Federation of Miners. The mining companies, upon request from a committee of business men, have extended the time of taking back former employees until Jan. 1. The business men throughout the district have planned a series of meetings and will endeavor to influence the men to return to their former places, and a number of these men have agreed to lend any financial aid required by any of the miners who return to work. A majority of the men still holding out are men that have lived in the district a long time, and it is desirable to have these men remain instead of bringing in a large body of new men. The mining companies have held off nearly

five months holding the jobs of the former employees open to them, and there is no spirit of animosity against the men. If the former employees insist upon holding with the federation there is nothing left for the mining companies to do but acquire outside labor. It is not a question of getting men for any number can be secured within a few days, the Calumet & Hecla alone has applications from over 1500 men, who desire to work in its mines.

SILVER CITY, N. M.—Dec. 15

Improvements at the El Paso Works of the American Smelting & Rening Co. and the increased capacity these improvements will create are evidences of the growth of the mining industry in the Southwest. That New Mexico is contributing to this development of the industry is shown by the Chino Copper Co., operating at Santa Rita. It is the largest producer in New Mexico at present, but within a few months an equally large camp will be established by the Burro Mountain Copper Co., at Tyrone. The methods used by these two companies are totally different, the Chino Copper Co. mining exclusively by steam shovels and the Burro Mountain Copper Co. working underground. Although the method of concentration of the latter company has not been announced officially, it is believed that the flotation process will be used. Chino treats its ore on tables and vanners. Both are low-grade propositions. East of the Chino property lies the Georgetown district, the producer at one time of over $7,000,000, also the practically undeveloped Carpenter zinc and lead district. To the west of the Burro Mountain copper property is the White Signal district, copper and gold properties barely scratched on the surface, and the exceedingly rich Lordsburg section. These districts are being examined by the representatives of large mining corporations, and the indications now are that New Mexico's mineral output will be considerably increased by the end of next year.

NEGAUNEE—Dec. 20

Forces at the Negaunee and Maas Mines of the Cleveland Cliffs Iron Co. at Negaunee, on the Marquette range, possibly are the largest in history of the properties. About 100 men were added to the payroll Dec. 1. Nearly 600 men are at work at the Negaunee, and nearly 300 at the Maas. It is expected that further additions will be made as underground development advances. Each mine is being operated on two 8-hr. shifts. There are no better equipped properties in the Lake Superior iron region than the Negaunee and Maas. Both have complete electrical hoisting, haulage, pumping and lighting plants, all of which are served by the company's hydro-electric works on the Carp River, near Marquette. A large amount of ore will be in stock by the opening of the 1914 season of navigation and with any considerable demand the year's shipments to the furnaces will establish new records for each mine. However, Cleveland Cliffs forces on the Marquette range in general are probably no larger than a year ago at this time. The Cleveland Lake mine at Ishpeming is being worked on single shift, where previously two shifts were employed. The 100 men affected by this curtailment were transferred to Negaunee and to the North Lake properties, west of Ishpeming. Three mines, the Smith, Mackinac and Gardner, in the Gwinn district have recently been put under development, and at the same time operations at older properties in the field have been scaled down. Some of the men formerly employed at Gwinn are now at work at Negaunee.

ISHPEMING—Dec. 20

A Tonnage Tax Law By Use of Initiative has been proposed and the state grange has indorsed it. The proposal to write, by direct action, this measure into the statute books has arisen because of the grange's failure, on two previous occasions, to procure its adoption by the state legislature. In that body the mining men frankly met the issue raised by the grangers and put up such a strong case that even men first disposed to look upon it favorably were won away from its support. Now the grange proposes, it seems, to appeal to a wider body of legislators than is sent to Lansing, and by resort to the people to obtain approval for a measure that they were not able to pass in an assembly small enough to give close attention to the merits of the arguments bearing on the issue. The question with which it is proposed to go to the voters is singularly complicated, and one that would be singularly difficult to deal with even if there was a general disposition to deal with it fairly and intelligently. At present there is a feeling of hostility toward the Michigan mines in general because of labor trouble in the copper country. The time for a fair consideration of the question in any program of direct legislation is thus not opportune, it is held in the mining region. There is still hope that a sense of fairness will show the sponsors of the plan that its discussion should be postponed until a time when it will not be complicated by bitterness growing out of an unusually stubborn labor strike.

Removing Overburden by Dredging is an innovation on the iron ranges that has been thoroughly tested during recent weeks. So far as can now be judged the method appears to be practical. The dredge, named "John B.," in honor of John Beckfelt, of Grand Rapids, discoverer of much of the ore in the region, is provided with a cutter at the front of the barge, which is revolved by twin Corliss engines, and as the material drops it is taken up by powerful suction pumps and forced through conveyor pipes to any required distance. These pipes are laid on pontoons, which may be swung into any position on the stream along which the work is being done, enabling the residue to be deposited as far from the dredge as may be necessary. The process was submitted to a particularly severe test when the discharge end of the conveyor pipe was placed at an elevation of 60 ft. above the intake and the flow obstructed by two right-angles and two angles of 45°. The pumps forced the sand and dirt through the lines satisfactorily. It is considered that as a result of this experiment, there will be no trouble in removing the entire overburden, although it will be necessary in some places to go down to a depth of 100 feet.

TORONTO—Dec. 20

Rice Lake Gold Mining District in Northern Manitoba, where operations have been quietly carried on for some time, is attracting some attention. Prof. R. C. Wallace, of Manitoba University, who has made an examination of the district, states that there is a marked similarity between the formations of Rice Lake and Porcupine, both of which differ considerably from those of Lake of the Woods and Rainy River. Six shafts have now been sunk with favorable results. On the Ranger claims owned by the Manitoba Mining & Exploration Co., Charles Andrews, who is in charge of development work, reports the opening up of a new vein 10 ft. in width extending 1500 ft. across the full width of the claim and rich in gold.

Reorganization Plans of the Canada Iron Corporation, which recently went into liquidation, are gradually being worked out, although as yet no definite basis has been decided upon by the committee of bondholders. A tentative scheme has, however, been outlined, which would necessitate deferring the security of the first- and second-mortgage bonds. First-mortgage bonds will be exchanged for second-mortgage bonds or debenture stock and the second-mortgage bonds, for preferred stock. An issue of first-mortgage bonds will then have to be made to provide working capital and it is stated that $1,500,000 is the amount under consideration. The size of this issue will, however, depend upon the extent to which the company will operate its various plants. If the mines and furnaces are to be operated immediately, a much greater amount of capital will be necessary, but if not, that sum should be sufficient. At present, only a part of the company's plants are in operation. The furnaces which have been operated at a loss, are now closed down and of the mines, only one at Bathurst was lately worked and this was shut down at the end of November. The foundry branch of the company is the only department which is being fully operated and this is returning a satisfactory profit. It is the intention of the company to keep only the foundries running during the period of reorganization and afterward to either sell or operate separately the mines and furnaces. New capital over and above that necessary to keep the foundries going will be required if the latter plan is adopted. The present working capital is provided by the issue of short-term notes and special arrangements have also been made with the banks. Temporary securities, ranking prior to all bonds outstanding, can be issued up to $250,000 to keep the foundries in operation until the permanent financing is arranged for. If the mines and furnaces are abandoned, the company expects to make a satisfactory profit and the present heavy fixed charges will be wiped out. While this company has in operation well equipped and uptodate foundry and pipe plants, the furnaces are too small and antiquated to permit of profitable operation under present economical conditions. The iron deposits at Londonderry are erratic and in general, low grade, while the Torbrook deposits are high in phosphorus. The Bathurst iron ore is a mixture of hematite and magnetite, averaging about 37% metallic iron and between 2 and 3% manganese. A concentrator was erected at a cost of $500,000 to enable the company to ship the higher-grade product, and while by this means it was possible to obtain a satisfactory ore, the losses and the cost of concentration were much greater than had been anticipated.

THE MINING NEWS

ALASKA

GOLD FROM FAIRBANKS WAS RECEIVED DEC. 10 at U. S. Assay Office at Seattle to the amount of $53,300. Shipments of gold for the season are practically completed.

FAVORABLE REPORTS FROM MATANUSKA-NELCHINA strike continue to come in and many prospectors are going in with complete outfits, with intention of staying all winter.

MOTHER LODE COPPER (Kennicott)—Force of 30 men will be employed through winter. A 7000-ft. tramway has been completed, and about 500 tons of ore are ready for shipment to Tacoma.

FAIR CHANCE (Fairbanks)—Vein, which was lost on this property on St. Patrick's Creek last spring has been found. It is 12 in. wide, and ore assays up to $100 per ton. Smith & McGlone, have a four year lease with option to purchase.

ARIZONA

Cochise County

CALUMET & ARIZONA (Courtland)—Curtailment of operations has been ordered. This does not mean cessation, although it is likely that nothing will be done until plans for future are worked out.

DENN-ARIZONA (Bisbee)—While there is nothing definite out with reference to resumption of development, there were further hints last week from northwest, indicating that preliminary steps, at least, have been taken, looking to starting up work, probably early in 1914. It will surprise no one to hear official announcement to that effect at any time.

HIGGINS LEASING CO. (Bisbee)—Company operating in Higgins Hill have been shipping steadily from sulphide-ore stope. Cunningham & Sowles on Wolverine lease are shipping oxide ore. Other lessees along upper end of district are also getting pay ore, and there is a growing belief that Tombstone cañon will yet turn out to be an important producer.

HERMITAGE (Hereford)—New 50-ton concentrator designed and built by A. F. Hazelton has been turned over to company after a satisfactory test run. Provision has been made for increasing capacity of plant as soon as best method of treatment has been determined and it is expected that custom ores from surrouding mines in Huachuca mountains will be treated here. Property was formerly owned by Huachuca Mining Co. and is in Montezuma cañon.

Gila County

ARIZONA COMMERCIAL (Globe)—Shaft has reached depth of 1350 ft. Work on 1200 is still suspended pending installation of pumping equipment to raise water recently encountered on that level.

SUPERIOR & BOSTON (Globe)—Crosscut on 600 level being driven to intersect vein, cut off by a fault, but subsequently relocated by diamond drill, has already been driven 60 ft. On 1000 level drifting in foot wall is in progress. Diamond drilling is still going on.

IRON CAP (Globe)—Underground ventilation is greatly improved since connection with Eureka shaft of Arizona Commercial was made. On 800 level drifting on vein is going on at rapid rate, at present being 245 ft. from shaft. Face is in excellent ore and management expects to encounter in another 50 ft. high-grade streak at present being worked on 650 level.

INSPIRATION CONSOLIDATED (Globe)—During November a total advance was made in underground workings of 3300 ft., 1136 ft. of which was in large drifts, 782 ft. in smaller drifts, and 1332 ft. in raises. Nearly all raises were lifted in Colorado orebody, only two raises being driven in Joe Bush section, as chutes for drawing ore from overlying ore dumps, or stockpiles. One of these two raises holed through into edge of stockpile Dec. 5. Connection was made with main east shaft on sixth level Dec. 6, and connection on same level with main west shaft should be made soon. On fourth level drift to shafts lacks only 200 ft. of being double width all way and widening continues at rapid rate. Work continues in main west shaft, timbering and other work prepatory to concreting being pushed ahead rapidly. Crushing plant at Scorpion shaft is again in operation crushing waste from that section of mine. Crushed waste is being used for filling holes and depressions near concentrator site. At concentrator concrete pouring is still in progress on retaining walls, now about two-thirds done. Machinery is being rapidly installed in test mill, 600-ton flotation equipment and all crushing machinery being erected. Steel for coarse crushing plant and main east and west shafts double headframe has arrived and has been unloaded. Considerable work has been done preparatory to erection of steel framework. Carpenters have cut away a portion of south side of main west shafthouse and wooden headframe now there and American Bridge Co. will lay track to allow crane locomotive to move to site of headframe. This spur will run directly over one compartment of main west shaft.

Maricopa County

A GOLD PROSPECT IN SALT RIVER MOUNTAINS, southwest of Tempe, is being developed by S. Johnson. Sinking will be continued until water is encountered as it is needed for use in a mill which is to be built later.

A NEW CAMP AT THE HEAD OF SYCAMORE CREEK, in the Mazatzal Mountains, will be established. Two wagons loaded with supplies have been sent from Phœnix to the camp, where a group of six claims formerly owned by Bowman & Reynolds was lately sold for $36,000. Development will be started at once. There is a good showing of cinnabar on all claims.

RELIEF (Peoria)—Cyanide plant is in operation and underground development is under way. Free gold in diorite is found.

ORO FINO (Phœnix)—Sinking has been discontinued and drifting on vein from 100-ft. level is in progress. One drift is in 60 ft. and other 40 ft. Good milling ore has been exposed.

MAMMOTH (Mesa)—Stamp mill is in operation and three carloads of coal have just been hauled to mine. Cyanide plant, which was lately completed, is also in operation. High-grade ore was recently encountered and much good milling ore has been opened up. At present 40 men are employed, but force will soon be increased.

Mohave County

GOLD ORE (Gold Road)—Property is shipping ore to Gold Road mill by auto truck. It is stated that minimum value of ore which can be mined and treated profitably is $8.50 per ton. Average ore runs about $3 better than this.

PITTSBURGH (Gold Road)—Property is being developed by S. R. Porter who has sunk a shaft to a depth of 100 ft. and has crosscut vein for 35 ft. An influx of water has recently stopped further development until means of handling it are provided.

COPPERVILLE (Hackberry)—New shaft is being sunk below 200-ft. level. Property is now equipped with modern 150-ton mill, steel headframe and a new hoist. There is a large body of good milling ore on 200-ft. level of new shaft which is being blocked out ready for mining.

Yavapai County

CLEOPATRA (Jerome)—A thorough and detailed survey of property has just been completed by J. D. Fisher, of Denver. Actual development work has been begun under direction of Major Pickerell. F. D. Stephen, who is in charge, has for new owners recently taken a half interest in Vulcan group of six claims and a fraction which adjoin Cleopatra as well as an option on other adjoining claims owned by Gibb & Fryer.

CALIFORNIA

Amador County

CENTRAL EUREKA (Sutter Creek)—A good vein of ore has been discovered in a drift from a winze below 3100 level. Development will proceed to sufficient depth to open other levels and drifts before starting mill again.

KENNEDY (Jackson)—It appears from further investigation that 12x12-in. timber broken by explosion which killed three men and injured another on Nov. 17 was broken square off 2 ft. from end, besides completing break at sawed portion and reducing that end of timber to splinters. Breaking in two of timber is taken as evidence that exploded powder was lying on timber at time of explosion. Timberman who survived is improving and it is possible that he may be able to state some facts regarding accident.

Calaveras County

LIGHTNER (Angels Camp)—Mine and mill are still in operation and a large force of men are at work.

UTICA (Angels Camp)—Work has been resumed at Cross shaft, after being closed down for about three months by shortage of water. Gold Cliff is operating steadily.

REINER MINING CO. (Stockton)—This company operating at Altaville in Angels Camp district, has filed a petition in bankruptcy in U. S. district court. John C. Benson, former president and manger, has been cited in superior court to show why he should not be restrained from selling stock in company. Benson in turn has brought suit against E. H. Ehrler, new president and manager, and others for $20,000 damages for alleged defamation of character.

Fresno County

AUBURY MINING CO. (Fresno)—Mine will be reopened and a five-stamp mill installed. Mine has been developed by a 45-ft. shaft and a 280-ft. tunnel.

Kern County

FIVE MEN WERE BURNED BY AN EXPLOSION of gas in a Standard well at Taft, Dec. 9. Men were taken to a hospital. Drill was down about 700 ft., when gas was encountered, which caught fire and enveloped workmen. Rig was destroyed.

Shasta County

NOBLE ELECTRIC STEEL CO. (Heroult)—After a shutdown since last July iron works resumed operation on Dec. 4 with blowing in of a 3000-kw. furnace with a capacity of 35 tons at a charge. A second furnace, 9000-kw., will be blown in in December. Coke has been substituted for charcoal.

Sierra County

MINERS' HOME (Downieville)—Pipe clay mixed with gravel, and prospecting well in heavy gold, has been opened up. A large washing plant has been built.

TELEGRAPH (Downieville)—New power house has been completed, replacing one destroyed by fire in October. Main tunnel is being repaired, and sinking on vein will be begun early in spring.

Siskiyou County

DEPOSIT OF $50,000 FOR STATE HIGHWAY BONDS has been made by Siskiyou County, which it had agreed to purchase. Work will begin as soon as rights-of-way are secured, starting at Oregon line.

COLORADO

Clear Creek County

SANTIAGO (East Argentine)—This mine is now producing about 8 tons per day, of $40 ore. Discovery of a body of copper ore has just been made on sixth level.

ANAMSA—Returns for 8 tons of ore from this mine on Columbia Mountain have been made by the Chamberlain sampler at Georgetown at 140 oz. silver per ton.

CAPTAIN JACK (Dumont)—In last 2½ years a tunnel 2000 ft. in length has been driven on property in Ohio gulch, and a series of veins intersected, one of which is now being drifted on, as it shows from 5 in. to 2 ft. of ore assaying up to $150.

San Juan Region

FRISCO MINES & TUNNEL Co. (Animas Forks)—This company operating Bagley tunnel has resumed work on property after a shutdown of several weeks. There has been expended here, according to reports, in excess of $650,000 in driving tunnel a distance of 5800 ft. and in developing some veins cut, such as Morgan and Red Cloud. A mill built in 1912-1913 to treat sulphide ores was not uniformly successful.

Teller County

SEVEREST STORM ON RECORD at Cripple Creek fell Dec. 4. Snow-fall is variously estimated at 3½ to 5 ft., while a high wind following day did great damage, blowing down power-line poles, stripping many shaft-houses of smokestacks and roofs, and drifting snow so that all railroading was at a standstill for over a week. Many sidings and spurs to mines are still blockaded, especially those having service of narrow-gage railroad; as a result several mines have suffered for lack of coal, while others are unable to dispose of ore. Few if any mines have resumed normal operation.

GOLDEN CYCLE (Goldfield)—Body of F. M. Woods, Jr., killed in cave of Dec. 1, was recovered Dec. 9, and those of his companions, Sam Sorensen and Pat Keveney, were recovered following day. Coroner's jury brought in a verdict that their deaths were caused by a faulty system of mining and by timbering stopes without filling with waste, but jury was unable to place blame. On account of power-line being out of commission during storm, electric pumps were drowned, and are now being recovered by bailing.

MICHIGAN

Iron

BALKAN (Crystal Falls)—Pickands, Mather & Co. have penetrated ore with a timber drop-shaft, which is now securely anchored in jasper. It will be sunk about 100 ft. more, when work of concreting will be commenced. Work of stripping other part of property will be started in spring, contract having been awarded.

JUDSON (Crystal Falls)—Shaft is rapidly nearing ore. It is 12x22 ft. inside timbers and is being sunk at an angle of 45°. It is 300 ft. from ore and by sinking it at an angle company has not been bothered much with a blanket of quicksand which overlies ore. Power house has been completed and machinery is being installed. A change house, machine shop, blacksmith shop, warehouse and office are now under construction.

ATHENS (Negaunee)—Steel headframe at this new property of Cleveland-Cliffs Iron Co. was completed last week as were all pulley stands. All steel work was done by Wisconsin Bridge & Iron Co. As engine house will stand on a hill at a considerable distance above collar of shaft, it was necessary to make pulley stands extremely high, one nearest shaft being 110 ft. high, probably highest in district. Engine house is partially completed and compressor is on ground and will be installed as soon as cement floor has been laid. All machinery will be operated by electricity. Shaft is down to ore but sinking was interrupted while headframe was being put in place. Work will soon be started but it will take two years to complete shaft which will be sunk 2300 ft. deep. Steel stocking trestles, 2000 ft. in length, will be erected in due time to take care of ore hoisted.

MINNESOTA

Cuyuna Range

BARROWS (Barrows)—New five-compartment shaft now down about 60 ft. Drifting is in progress from No. 2 shaft toward new one, to afford drainage.

BRAINERD-CUYUNA (Brainerd)—All machinery now in place and steam plant in operation for first time on Friday, Dec. 12. Shaft now down 55 ft., with 45 to go.

ROWE (Riverton)—Continued mild weather permits operation of hydraulic plant much later than was anticipated. One steam shovel is also at work stripping. Soo Line is constructing a roundhouse near property, in anticipation of heavy shipments next season.

KENNEDY (Cuyuna)—Rogers-Brown Ore Co. has completed installation of electrical equipment. A five-ton Goodman electric locomotive is used underground, hauling ten three-ton cars. On surface, a three-ton General Electric locomotive is used. The 1914 ore contracts have not yet been made, so that next year's tonnage cannot be ascertained. A 150,000-ton stockpile will be accumulated this winter.

CUYUNA IRON & MANGANESE ORE CO. (Crosby)—After drilling 41 holes, company announces that it will strip orebody next season and operate same as an open pit. Property adjoins Pennington mine on north, but is not on same lens of ore. New orebody is a manganiferous iron-ore deposit of low grade, while Pennington ore is practically free from manganese. Overburden varies from 45 to 60 ft. in depth, and is as usual on Cuyuna range, sand and gravel. Property was drilled some years ago by Republic Iron & Steel Co., but was dropped because of its low iron tenor, manganese at that time not being considered. Company is a stock company with its shares more or less scattered throughout Northern Minnesota, and more stock is now being offered by promoters.

MISSOURI—KANSAS—OKLAHOMA

Joplin District

COATS & ORTT (Thoms Station, Mo.)—New orebody is being developed.

POWER MINING CO. (Klondike, Kan.)—Rich ore being worked at 180-ft. level; concentrator running steadily.

LUKE LAND (Webb City, Mo.)—Eighth drill hole shows good ore. J. M. Short and associates of Joplin hold lease.

CULPEPPER (Carterville, Mo.)—Concentrator is being removed from Cunningham land to Kane lease by Dexter Mining Co.

ALLIANCE (Neck City, Mo.)—Concentrator has been purchased by S. L. Walker, to be removed to lease. Good mine opened, with extensive orebody.

BATTLE AXE (Alba, Mo.)—Another big lead strike has been made, 6-ft. face of rich ore being opened. Johnson & Underwood are operating property.

QUAKER MAID (Spurgeon, Mo.)—Eastern company has purchased mine and will install modern equipment throughout. Mine has been consistent producer.

BEAR CAT (Sarcoxie, Mo.)—Lease has been taken by Joplin operators. Concentrator has not been operated for several months. Formerly worked by Grasselli Chemical Co.

HUDSON ZINC CO. (Belleville, Mo.)—Exceptionally rich strike made by drilling by Franklin Smith and associates of Joplin. Drill has been in mineralized ground from 45- to 82-ft. level.

WALKER LAND (Duenweg, Mo.)—Two new concentrators now running. Home company taking out both lead and zinc at 105-ft. level. Zinc ore found in virgin ground by Lora D. company.

SAPULPA (Webb City, Mo.)—Mine has been sold by Charles Moore & Co. to J. M. Short & Co., of Joplin, includes 250-ton mill, 30-acre lease, with three shafts in ore. Will be known as Tecumseh.

CENTENNIAL LEAD & ZINC CO. (Joplin, Mo.)—This new company is operating Little Jewell, with concentrator, and two additional shafts on lease. Ore from three shafts shows heavy mill recovery.

POCAHONTAS (Thoms Station, Mo.)—Company recently sold 650 tons of blende concentrates, held off market several weeks, bringing approximately $25,000. Cave-in recently

DIPLOMAT (Galena, Kan.)—Two drill holes put down on Galena Lead & Zinc Co. land showed rich cuttings. First showed zinc ore, second lead ore. Drilling campaign to continue, with shafts to be sunk later.

MONTANA

Granite County

RICH COPPER ORE AT PHILIPSBURG has attracted miners, leasers, prospectors and investors in great number to old camp. It has always been contended by those familiar with district that in southern part of Granite County are large deposits of high-grade copper ore . This belief was strengthened a few months ago by strike in North Star mine near Maxville, of a copper vein, 35 ft. wide, rich in silver and containing up to 35% copper. Following this strike came discovery in Swastika mine of orebodies not only rich in gold and silver, but running as high as 26% in copper. These mines are being equipped with modern conveniences and appliances for mining on a large scale. Should results of operations equal expectations, Philipsburg and Granite County, once made famous by old Bi-Metallic mines may again enter ranks of modern mining camps.

Silver Bow County

SAFETY APPLIANCE FOR BUTTE HOISTS were demonstrated in presence of a large number of officials of Anaconda Copper Mining Co., Welch hoisting engine controller was given a practical test at Mountain-View mine. It proved so successful that various companies are making plans to adopt appliance. Efforts made by operating engineer to have engine run away by starting one side with a descending cage, were frustated by automatic application of brakes when regular hoisting speed was exceeded. Similar efforts to cause overwinding were counteracted by safety device in stopping engine before danger point was reached.

BUTTE ELECTRIC WORKERS VOTED AGAINST STRIKE —Information was given out by F. Beckwith, president of district council of electrical workers, that strike vote in the Montana locals had failed by a vote of 147 to 113. A proposition to reunite local factions of electrical workers under jurisdiction of American Federation of Labor is to be submitted to a referendum of members of different locals. An agreement to unite will insure future harmonious working of local members of electrical workers with other labor unions in Butte and make a sudden declaration of strike by local members impossible. Such a strike was threatened a few months ago, involving closing down of all mines and other industries in Butte.

ANNUAL REPORT OF STATE MINE INSPECTOR, W. B. Orem, contains following interesting items concerning Butte camp: About 13,000 men are employed in mines of Butte. Amalgamated Copper Co. expenditures in state were about $40,000,000, which is equal to $100 per year for every man, woman and child in state. All mines of Anaconda company are now connected by one general level known as 2000-ft. level and extending into Leonard, West Stewart, Tramway, St. Lawrence, Diamond, Original and Anaconda. Electric power is utilized in all branches of mining. A telephone system has been installed to bring all parts of all mines, surface and underground into communication with each other. No labor troubles have been experienced during year. Miners receive highest wages paid in any mining camp of country and are contented with work and working conditions. To minimize accidents, Anaconda company is offering prizes to foreman of mine in which minimum amount of accidents happen. Daily output of copper ore is about 15,000 tons per day, of zinc ore about 1000 tons. Butte is fast developing into a large zinc producer.

BUTTE-BALLAKLAVA COPPER CO. (Butte)—To clear up erroneous reports, regarding Anaconda-Ballaklava litigation, C. F. Kelley, vice-president of Anaconda Copper Mining Co. issued following statement: "Approximately 850 ft. measured on strike of vein was in dispute. Large orebodies on west end of vein were being mined by Ballaklava company when suit was instituted. Under terms of settlement each party takes about 425 ft. of vein on strike. Anaconda taking west 180 ft., said to contain valuable orebodies; then Ballaklava takes its 425 ft. to an easterly boundary plane; Anaconda taking rest of its 425 ft., or 245 ft. on east end of vein. A vertical southerly boundary was established, terminating Ballaklava rights to vein on its dip. This plane will be reached approximately on 3000-ft. level. No block of ground outside Ballaklava claim has been awarded to Ballaklava. Future owners of each segment of vein have a right to veins which may dip into main vein after latter has passed south of Mountain Chief claim and into Ballaklava. Settlement clearly recognizes apex law and statement that this settlement will affect other apex litigations has no foundation. Active mining was resumed at Ballaklava Dec. 2. Since then one car of ore has been shipped daily to Washoe smelter. Stopes are being opened on 800, 900, 1200 and 1400 levels. When this is accomplished, development work on all levels will be carried on and crosscutting for big vein will be started. Mine is well equipped for operation on a large scale, equipment consisting of a steel ore bin of 400 tons capacity, two compressors, a 300-hp. electric hoist, an auxiliary 165-hp. hoist and repair shops.

NEVADA

Clark County

POTOSI (Goodsprings)—This property, formerly owned by Mahoney Bros., of San Francisco, has been taken over by Empire Zinc Co., at a consideration said to be $125,000. Property has been producing throughout year, about 750 tons monthly of zinc ore, averaging 38% zinc and 8% lead, and it is expected that new company will increase this production materially. Plans are under way to build a tramway from mine to Summit, a distance of two miles, and a motor-truck road thence to railroad at Arden. Motor trucks will be used for ore haulage.

YELLOW PINE (Goodsprings)—Work has been started on new two-compartment shaft which is to be driven 600 ft. to tap new orebody on seventh level. Work is to be pushed to completion as rapidly as possible, three shifts being engaged in sinking, using Torpedo air drills. It is expected that men will make a record for shaft-sinking in this vicinity. Orders have been placed for entire equipment for new power plant and hoist at mine, which is expected to be fully erected within 60 days. New orebody is being rapidly developed from old workings and a large tonnage of lead and zinc-carbonate ore is already blocked. Output for November was slightly less than heretofore, owing to inclement weather but a total of 1500 tons of zinc concentrate, 300 tons of lead concentrate and 200 tons of crude ore was shipped to smelters. Regular monthly dividend was declared Nov. 25, 2c. per share, and a similar amount has been declared payable Dec. 25, which makes the total dividends for the year $218,500.

Churchill County

URANIUM ORE OF GOOD GRADE has been discovered between Wonder and Fairview.

Humboldt County

SHEA-KELLEHER LEASE (Rochester)—An oreshoot 10 ft. wide has been opened in lowest level. Shipments will commence at once.

HIGHLAND NATIONAL—Situated 30 miles from Battle Mountain will start development at once. Large Silver-Lead vein has been opened.

SILVER BELT R.R. (Rochester)—Terminus will be swung to foot of Rochester Cañon, where ore bins will be built. It is planned to extend road up Rochester Cañon to foot of Lincoln Hill. This will necessitate addition of a Shay engine to rolling stock.

Lander County

LONDON (Tenabo)—Crosscut tunnel is being driven.

ASPEN (Tenabo)—Shaft is being sunk. Good-grade lead-silver ore has been discovered.

VIOLET (Tenabo)—Shaft has been sunk to 200-ft. level and drifts driven both ways. Results of this development justify further work.

Lyon County

A GOLD DISCOVERY has been made on east side of Mason Valley about eight miles from Yerington.

Mineral County

YERINGTON MOUNTAIN (Yerington)—Crosscut on 500-ft. level has cut oreshoot 20 ft. wide, at distance of 300 ft. from shaft. Copper minerals are sulphides and black oxide and ore will assay 6%. It is planned to drive 2200-ft. crosscut tunnel to cut vein at depth of 1200 ft.

Nye County

MERCURY MINING CO. (Ione)—Weekly production is now 20 to 30 flasks.

BRADY LEASE (Manhattan)—During 1913 mill treated 10,000 tons ore with estimated value of $100,000.

VALLEY VIEW (Manhattan)—Development has opened shoot of milling ore with streaks of high-grade in limestone.

MANHATTAN CONSOLIDATED (Manhattan)—Will reincorporate in Nevada and make new company an assessable corporation.

NEVADA CINNABAR CO. (Ione)—Development has proved several years' supply of ore, it is stated. Distillation plant is nearing completion.

COMMERCIAL MINES & MILLING CO. (Manhattan)—War Eagle mill will obtain ore supply from Mustang mine during winter months, weather conditions making production from Reilly fraction glory hole too uncertain. Ore from Mustang mine is trammed directly into mill.

NEW MEXICO

Bernalillo County

PLACERS IN GOLDEN DISTRICT in Santa Fé range are to be reopened by Col. J. A. Wood.

Grant County

PHELPS-DODGE (Tyrone)—It is rumored that newly constructed railroad from Whitewater to Tyrone may be extended to Mogollon and thence to company's coal fields. Line for this road was surveyed by J. V. Bergen about 10 years ago. Such a road would not pass through town of Mogollon, but near enough to transport supplies to district.

STEEPLE ROCK CO. (Lordsburg)—All claims owned by company, a subsidiary of London Development Co., have been placed on market for lease or sale by Sanford Robinson, of Los Angeles, who has been working on this proposition for some time. Jim Crow group is said to be valuable property, and has yielded much high-grade ore. It is now under water, but it is estimated that two carloads of ore would pay for unwatering. A. B. Ream, of Lordsburg, and his associates, have taken a lease on Carlisle group and intend to commence work on property immediately.

Otero County

JAMES G. BARRETT (La Luz)—Improvement work is being done upon property a short distance northeast of La Luz.

Santa Fé County

COPPER ZONE MINING & MILLING CO. (Cerrillos)—A license has been granted this company, a $150,000 corporation of Arizona, to transact business in New Mexico. Headquarters will be at Cerrillos. E. B. Ames, agent.

Socorro County

A NEW SAWMILL AT COONEY has been put into operation and will supply district with construction lumber and mining timber. Plant has installed finest and latest mill equipment and is a welcomed industry into this prosperous district, where it was greatly needed.

ERNESTINE (Mogollon)—Company started custom milling, Dec. 1, being third ore buyer now in field. Additional tanks are being added to plant.

GRAPHIC GROUP—A record is being made by this group of the Ozark company, with large bodies of ore in sight, aërial tram and mill.

LITTLE CHARLIE (Mogollon)—Pipe connections have been made with Maud S. compressor, and machines are now used in ore breaking. Shipments to custom mill have been resumed.

LINCOLN MINING & DEVELOPMENT CO. (Cooney)—Complaint has been filed by this company with state corporation commission in which it requests corporation commission's opinion on charges made by telegraph companies in Silver City for messages telephoned to their offices.

Taos County

ROUND HILL GOLD PLACER MINING CO. (Upper Rio Grande)—Operations have been closed down on account of ground freezing.

OREGON

Baker County

HUMBOLDT (Mormon Basin)—About 57 men are now on pay roll at this mine, which is largest producer in Oregon. Ten-stamp mill is running night and day, and much development work is also being done.

Josephine County

BONDS FOR THE GRANTS PASS TO COAST R.R. have been issued by city council of Grants Pass, which accepted bid of Keeler Bros., of Denver, Colo., for the $200,000 issue. Money will be available soon. Much of the road has already been graded.

CHAMPLAIN DREDGE (Foots Creek)—This dredge, about two miles above the mouth of creek, is to be put in operation again after being idle for several years and tied up until recently in litigation.

SOUTH DAKOTA

Lawrence County

NEW RELIANCE (Trojan)—Diamond drilling has been started, and will be continued for several months. It is in nature of exploratory work. Mill is operating at full capacity.

OLD IRONSIDES (Squaw Creek)—A long tunnel is being run to develop orebody at greater depth and afford a more direct means of extraction. Last shipment went to Golden Reward mill, at Deadwood, and is reported to have been of excellent milling grade. It is hoped to have mine opened by next summer, so that regular shipments of both smelting and milling grades can be made.

HOMESTAKE (Lead)—Benefits paid by Aid Fund are to be increased Jan. 1 to $1000 in case of accidental death, and $800 in case of death from illness; increase of $200 in each benefit. Plastering of "Recreation Hall" is nearly finished, and carpenters are at work on interior. Addition to assay office will be inclosed in a few days. Good progress is being made in removing buildings from sites of improvements recently decided upon.

TITANIC (Carbonate)—At a depth of 150 ft. Combination shaft has entered a mineralized formation, and management has decided to crosscut at this depth to a porphyry dike on east. At same time sinking is to be continued to 300-ft. level. Machine drills recently ordered are now working, and better progress has been made. Supplies for several months' run have been received, and heavy snows will not now materially affect operations.

Pennington County

CONTINENTAL COPPER (Sheridan)—The 800-ft. shaft is nearly unwatered, and sinking will soon be resumed. Property is equipped with a good mining plant.

TENNESSEE

Knox County

AMERICAN ZINC, LEAD & SMELTING CO. (Mascot)—The company has established what is believed to be a unique record, because in seven months it has brought its new Tennessee mill up to full capacity, mill now treating in excess of 1000 tons of ore daily, and at times it has treated as high as 1150 tons of ore in one day. Concentrates are running from 60% to 62% zinc, being made from an ore assaying about 40% zinc. Spelter made from these concentrates commands a premium, owing to its exceptional purity, and concentrates bring a premium of from $5 to $7 per ton over concentrates of like grade produced in Joplin district. Holston orebody, from which current ore is being mined, has already blocked out 1,750,000 tons, or an ore supply of from five to six years with present milling capacity. This tonnage, however, does not represent possibilities of this particular orebody. At a distance of about 800 ft. away another orebody has been encountered, average being in excess of 5½% zinc and over 2,000,000 tons being in sight.

UTAH

Box Elder County

HARD ROCK (Golden)—Salt Lake men have recently inspected Hard Rock or Carter gold property, eight miles west of Century mine. If this ground is taken over, a mill will probably be built.

Juab County

TINTIC SHIPMENTS for week ended Dec. 12 amounted to 169 cars. Preparations are being made to ship low-grade ore from a number of dumps in southern end of district; ore will be placed on cars at Silver City. A test shipment has been made from old Copperopolis mill near McIntyre ranch. This dump, as well as those at Blue Bird, Tesora, La Clede and Joe Bowers is under lease. It is thought a considerable tonnage can be shipped at a small profit. A car of ore from Blue Bird dump is being prepared for market.

BALTIMORE (Eureka)—A contract for driving a short tunnel has been let.

SELMA (Knightville)—Operations have been resumed after a shutdown of several months. A new hoist is to be installed, grading for which is in progress.

OPOHONGO (Robinson)—Two drifts are being driven in upper workings; one is crosscutting a promising body of quartz; and other will prospect ground under oldest workings of mine.

EAGLE & BLUE BELL (Eureka)—Good progress is being made in sinking shaft, and it is expected that a station will be cut at 1500 level about Christmas time. Although regular work of mine has been somewhat hampered by new development, 75 tons of ore daily were mined and hoisted in November. During this month, shaft was advanced 160, ft. leaving 58 ft. including sump still to be completed.

Salt Lake County

ALTA CONSOLIDATED (Alta)—A seam of ore has been followed by winze from main tunnel level, and has opened out to 1 ft. in width. Material runs well in copper and silver.

OHIO COPPER (Bingham)—An avearage of 2300 tons of ore is being mined and milled daily. After adjustments and changes now being made under Mr. Waddell's direction have been completed, it is expected that recovery of 45 to 50% will be somewhat bettered.

CARDIFF (Big Cottonwood)—Ore is being sent down on sleighs to Burnt Flat near Maxfield mine, where it is transferred to wagons. Lower tunnel is in over 1600 ft. and work is being continued there.

MICHIGAN-UTAH (Bingham)—Ore is being hoisted through new raise connecting old Coalition workings with City Rocks. This makes it possible to work both Big and Little Cottonwood sections to advantage, and send ore down Little Cottonwood over tramway. Lessees are making shipments from Cleaves tunnel in City Rocks ground.

Tooele County

PRIDE OF THE WEST—It is reported that work will be resumed at this property.

WASHINGTON

Chelan County

ENTIAT (Entiat)—This company has taken over Rex property, and preparations are being made for installation of stamp mill and cyanide plant.

Clarke County

LEWIS RIVER MINING CO.—For not having a fish ladder in dam on Lewis River and for polluting waters of river through mining operations this company has been fined by fish warden and will pay a fine of $97.50. Company has been washing gold from gravel bars along river. Portland people are back of enterprise. It is not known how pollution of water can be prevented.

Spokane County

DEER CREEK MINING CO.—This company has been organized to take over property of H. & M. Mining Co., and will install cyanide plant.

BUTTE-CHEWELAH (Chewelah)—A gasoline hoist and two-drill compressor have been installed, and operations will be continued throughout winter.

WYOMING

Crook County

BEAR LODGE (Bear Lodge)—A new compressor and boilers have just been received, and will be in commission soon. Lumber is being sawed and delivered for mill construction, work upon which will be started early in spring. Principal workings show ores heavy in fluorite, occurring in a country of phonolite. Some veins are small and ore is rich; tellurides are frequently found. Company experienced considerable trouble in getting patent to its property, land being in a forest reserve, but now title has been perfected. Boston men are interested.

CANADA

British Columbia

SULLIVAN (Kimberley)—Diamond Drill Contracting Co., of Spokane, is drilling this property for Consolidated Mining & Smelting Co.

QUEEN VICTORIA (Nelson)—October output of this mine of British Columbia Copper Co. was 3581 tons, bringing total shipments for 1913 up to 22,807 tons.

VAN ROI (Slocan)—During October output was 1207 tons, yielding 30 tons of lead concentrates assaying 107 oz. silver, 49.1% lead, 12.6% zinc, and 72 tons zinc concentrates assaying 26.1 oz. silver, 1.8% lead and 40.3% zinc. Mill ran 203 hours.

HEDLEY GOLD MINING CO. (Hedley)—A new crusher has been ordered for mill and will be installed shortly. It is of much greater capacity and later pattern than old one, and will expedite and cheapen crushing of ore before it reaches batteries.

JOSIE (Rossland)—Mine produced 1600 tons of ore and 103 tons of concentrates in October. Smelter payments for month were $31,975 for 1638 tons of ore and 141 tons of concentrates. Estimated expenditures for same period were as follows: Development, $7000; mining ore, $10,500; milling, $1250; total, $18,750.

OLD SPORT—Maurice W. Baker, general manager of Stewart Mining Co., denies that he and his associates have purchased this group of claims on Vancouver Island. Company has taken a long-term lease and bond on group, which embraces 600 acres, and is traversed by a number of veins showing gold, silver and copper.

GRANBY CONSOLIDATED (Anyox)—Anyox already has appearance of a flourishing mining town where only a few months ago there was practically nothing but rocks and trees. Large saw mill, mess and bunk house accommodates about 500 men, there is another camp at dam, also a large mess and bunk house at mines. A spacious school building has been erected. Granby Bay Hotel Co. runs a splendidly equipped hotel, all bedrooms having electric light, hot and cold water, and telephones. Recreation hall and pool room is close by, and a grand ball was recently given by Mr. Manly, the hotel proprietor, to celebrate opening of that building. A social club has since been formed, and it is proposed to devote at least one evening a week to dancing. Moving pictures are put on in reaction hall on Monday and Tuesday evenings. At the limestone quarry at Swamp Point a force of about 30 men is employed. Two tunnels have been driven, from which raises will be put up to surface and a wharf has been built.

Ontario

ORE SHIPMENTS FOR NOVEMBER were as follows: Crown Reserve, 54.77 tons; Coniagas, 128.75; Cobalt Comet (Drummond), 37.56; Cobalt Townsite, 653.75; Cobalt Lake, 83.26; Kerr Lake, 49.48; La Rose, 516.66; McKinley Darragh, 209.36; Nipissing, 121.63; Peterson Lake (Seneca Superior), 39.66; Penn Canadian, 145.32; O'Brien, 42.97; Right-of-Way, 40.26; Tretheway, 46.67; total, 2170.10 tons.

TIMISKAMING & HUDSON BAY (Cobalt)—A dividend of 300% payable Dec. 22 has been declared.

PAN SILVER (Cobalt)—Shareholders have authorized issue of 350,000 shares of treasury stock at 10c. per share.

JUPITER (South Porcupine)—It is announced that issue of $50,000 one year bonds has been taken up by shareholders

VIPOND (South Porcupine)—This property which was recently under option to Crown Reserve people, is now being examined for West Australian Gold Mines, Ltd.

WRIGHT-HARGRAVES (Swastika)—Work on this property which is under option to B. Cartwright and associates, has been discontinued.

PAN SILVER (Cobalt)—A special meeting of shareholders has been called to ratify two bylaws, one of which provides that 80,000 shares be issued to Coleman Development Co. in payment for property and other authorizing sale of rest of treasury stock at 10c. per share.

NORTHERN CUSTOMS CONCENTRATOR (Cobalt)—Half the 80 stamps in new mill will be started dropping Dec. 15, while remainder will be in operation a few weeks later. Construction of this mill constitutes a record for this part of country, as ground was broken for foundations first week in September. First ore treated will be from La Rose mine. Company also has a contract commencing next May for operation of 20 stamps for Chambers-Ferland.

Quebec

MANITOU IRON MINING CO. (Montreal)—This company owns and operates a large deposit of ilmenite ore at Ivy-on-the Lake. Analysis of mineral from different plans on property show Titanic oxide, 38%; iron oxide, 57% lime, silica and magnesia 5%; no sulphur nor phosphorus.

MEXICO

Sonora

LOS ANGELES (Nacozari)—W. R. Lane, manager, has purchased a large boiler. Shaft will be pumped out and mine will again be a producer.

MEXICAN DEVELOPMENT CO. (Peoria, Ill.)—Contract for sinking a two-compartment shaft at Quelitlan mines in Autlan district an additional 100 ft. has been let. Shaft now is 110 ft. deep. Three shoots of high-grade copper ore have been cut. Company's plans call for a 100-ton smelting plant. Mines are 18 miles from Pacific port of Chamela.

TRANSVAAL

GOLD PRODUCTION IN THE TRANSVAAL in November was: Witwatersrand, 644,320 oz.; outside districts, 29,166 oz.; total, 673,486 oz. This is 44,945 oz. less than in October and 54,211 oz. less than in November, 1912. For the 11 months ended Nov. 30 the total was 8,347,893 oz. in 1912, and 8,122,009 oz.—or $167,881,926—in 1913; a decrease of 225,884 oz. this year.

THE MARKET REPORT

METAL MARKETS

NEW YORK—Dec. 24

The metal markets continue rather quiet. Copper has not lost materially, but sales have been on a moderate scale. Tin has been generally weak and lower.

The recent weakness in copper, lead and spelter has not been due to any malevolent manipulation, or any other mysterious motives, but is explained by the absence of buying for consumption and the increase in smelters' hands of stocks that they were averse to carrying. Sales at low prices have relieved the situations in copper and lead. There has probably been no reduction in the stock of spelter, but producers seem to be willing to carry that metal. In all of these metals, the present outlook is for improvement in price.

Copper, Tin, Lead and Zinc

Copper—During the week of Dec. 18-24 there was active competition for business among all the agencies, which resulted in considerable sales; however, at low prices. The bulk of these were with European buyers and were done at 14.30@14.35c., delivered in Europe. One day one agency would cut; another day, another. Some business was also reported with American consumers, including one or two round lots, at about 14¼c., delivered, usual terms. On Dec. 23, one of the principal agencies, having apparently sold all it cared to, announced an advance in its asking price to 14⅝c., delivered, usual terms, other agencies being then sellers at 14¼ @14¾c. delivered, etc. The action of the agency referred to was not followed entirely by the others, but they stiffened up somewhat and made the market at about 14⅜@14½c., delivered, etc., equivalent to about 14.25@14.30c., cash, N. Y., on Dec. 24.

The situation in Lake copper remained about as previously reported, the principal producer asking 14⅞@15c., and presumably taking care of its regular customers at those prices. An outside lot of 150,000 lb. turned up on Dec. 23 and was sold at 14¾ cents.

There is a decidedly better feeling in the market, which closes strong with lake copper at 14⅜@15c.; and electrolytic in cakes, ingots and wirebars at 14.25@14.30c. The average price of electrolytic for the week was 14.158 cents.

We quote casting copper nominally at 13.90@14c. as an average for the week.

For some time past the three months standard copper at London has been selling below cash standard. Of late, the backwardation has disappeared, and this week, for the first time, a contango has been again established, and standard closes at £64 15s. for spot and £65 5s. for three months. This reflects the change in sentiment on the part of the European speculative public toward copper, and indicates an expectation on their part of an improvement in the market.

Base price of copper sheets was reduced ½c. per lb. on Dec. 17, and is now 19¾c. for hot rolled and 20¾c. for cold rolled. The usual extras and discounts are charged and higher prices for small quantities.

Exports of copper from New York for the week are reported at 9907 long tons. Our special correspondent gives the exports from Baltimore for the week at 1231 tons.

Tin—The decline in the London market has made further progress. However, sellers of the metal displayed no great anxiety to meet the lower quotation and were reluctant in making offers. Domestic interests transacted considerable business, especially for futures, among themselves, but some buying was also done by consuming interests. The market closes steady at £167 10s. for spot and £169 5s. for three months, and about 36¾c. for January tin here.

Lead—Independent producers having sold all they cared to at low prices and pretty well relieved themselves of accumulated stocks, the market passed entirely into the hands of the A. S. & R. Co., which filled orders at its prices, wherefore the advance in St. Louis, where lead became unavailable below the A. S. & R. Co.'s scale. During the morning of Dec. 24, the A. S. & R. Co. advanced its price to 4.10c., New York. The St. Louis market was quoted at 3.95@4.00c., rather uncertain, the action of the leading producer taking it by surprise. Lead sales for the week were rather large, a good many thousands of tons. There was buying both by consumers and by speculators. There were some inquiries for future deliveries, but producers were averse to entering into such contracts except at premiums corresponding to carrying charges.

The London market is unchanged, Spanish lead being quoted £17 15s. and English lead 12s. 6d. higher.

Spelter—Small sales were made at 5c. right through the week. The principal consumer continued conspicuous by its absence. Buyers showed some interest in talking about future deliveries, but producers were unwilling to sell such except at premiums, which buyers apparently did not want to pay. All kinds of asked prices are named for this metal, sellers expecting an advance and desiring to protect themselves against surprises.

The London market is firmer, good ordinaries being quoted £21 7s. 6d. and specials 7s. 6d. higher.

DAILY PRICES OF METALS

NEW YORK

Dec.	Sterling Exchange	Silver	Copper		Tin	Lead		Zinc	
			Lake, Cts. per lb.	Electrolytic, Cts. per lb.	Cts. per lb.	New York, Cts. per lb	St. Louis, Cts. per lb.	New York, Cts. per lb.	St Louis, Cts. per lb.
18	4.8515	57¾	*14¾ @15	14.10 @14.15	37¼	4.00	3.85 @3.90	5.12½ @5.17½	4.97½ @5.02½
19	4.8520	58	*14¾ @15	14.10 @14.15	37	4.00	3.87½ @3.92½	5.12½ @5.17½	4.97½ @5.02½
20	4.8530	58	*14¾ @15	14.10 @14.15	37	4.00	3.87½ @3.92½	5.12½ @5.17½	4.97½ @5.02½
22	4.8525	57⅞	*14¾ @15	14.10 @14.20	36¾	4.00	3.90 @3.95	5.12½ @5.17½	4.97½ @5.02½
23	4.8525	57½	14¾ @15	14.10 @14.20	36¾	4.00	3.90 @3.95	5.12½ @5.17½	4.97½ @5.02½
24	4.8520	57½	*14¾ @15	14.25 @14.30	36¾	4.10	3.95 @4.00	5.12½ @5.17½	4.97½ @5.02½

*Nominal.

The quotations herein given are our appraisal of the markets for copper, lade, spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.15c. apart. The quotations for electrolytic copper are for cakes, ingots and wirebars. The price of electrolytic cathodes is usually 0.05 to 0.10c. below that of electrolytic; of casting copper 0.15 to 0.25c. below. The quotations for lead represent wholesale transactions in the open market for good ordinary brands, the specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals; per 100 lb., are: St. Louis-New York, 15½c.; St. Louis-Chicago,6c.; St. Louis-Pittsburgh, 12½c.; New York-Bremen or Rotterdam, 15c.; New York-Havre, 16@17½c.; New York-London, 16c.; New York-Hamburg, 18c.; New York-Triesta, 22 c.

LONDON

Dec.	Silver	Copper				Tin		Lead		Zinc	
		Spot		3 Mos.	Best Sel'td	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
		£ per Ton	Cts. per Lb.								
18	26 11/16	64¼	13.96	64¼	69¼	169¾	171½	17⅞	3.88	21⅜	4.64
19	26 17/16	63¾	13.85	63⅞	69	169	170½	17⅞	3.88	21½	4.67
20	26 13/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	26 13/16	64 3/16	13.95	64⅜	68	168¾	169¾	17¾	3.86	21½	4.67
23	26⅛	64¼	13.96	64¾	69	167¾	169¼	17¾	3.86	21½	4.67
24	26 11/16	64	14.07	65⅛	69¼	167½	169¼	17¾	3.86	21⅜	4.64

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latte being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.26c = £25 = 5.44c.; £70 = 15.22c. Variations, £1 = 0.21¾c.

The base price of sheet zinc in carload lots is now $7.25 per 100 lb. basis, less 8% discount, f.o.b. cars, Peru, Ill.

On Dec. 18, at a meeting held at Frankfurt-am-Main, the International Zinc Syndicate was extended to April, 1916, the terms being practically the same as heretofore. It was said that the stocks of spelter which had accumulated during 1913 had been greatly reduced.

According to our European advices, the buying of spelter in Europe has been decidedly better since the Syndicate was completed. The Syndicate's price is £21 1s. 2d. for December shipments, and £21 5s. 8d. for January, corresponding to about 5½c. New York.

Other Metals

Aluminum—The market continues quiet, with moderate sales, and no pressure either from buyers or sellers. Prices are a shade easier and quotations are 18½@19c. per lb. for No. 1 ingots, New York. The foreign market is quiet but steady.

Antimony—The trade has been quiet; in fact only a retail business is being done just now. Prices are unchanged. Cookson's is quoted at 7.40@7.60c. per lb., and Hallett's 7⅛@7⅝c. For Hungarian, Chinese and other outside brands 6@6¼c. is named.

Quicksilver—A fair business is reported and the market is steady, with no change in prices. The New York quotation is $39@40 per flask of 75 lb. for large lots. The jobbing price for small orders is 54@56c. per lb. San Francisco, $39 per flask, with special terms for export. London price is £7 10s. per flask, with £7 5s. quoted from second hands.

Gold, Silver and Platinum

Gold—There was no change in the open market in London, and the price of gold remained at the Bank level, 77s. 9d per oz. for bars. There is some apprehension felt in London of a possible demand for gold from New York.

Imports of gold in France, 10 months ended Oct. 31, were 559,351,000 fr.; exports, 58,959,000 fr.; net imports, 500,392,000 fr., against 178,154,000 fr. last year.

Imports of gold in Great Britain 11 months ended Nov. 30 were £54,588,642; exports, £44,044,028; excess of imports, £10,544,614, which is £4,008,899 more than last year.

Iridium—No change is reported and dealers continue to ask $80@81 per oz. for pure metal, New York.

Platinum—The market continues rather easy, but no change in prices is noted. Reports come from abroad of a probable advance in prices, but they attract no attention here. Prices are easier at $42.75@43.50 per oz. for refined platinum, and $47@50 per oz. for hard metal.

Our Russian correspondent writes, under date of Dec. 10, that the market shows no change. The supply of small lots from the mines is large for the season, and is quickly taken up. No large sales are reported, and some sellers are still holding for an advance. Quotations for crude metal 83% platinum are 9.55 rubles per zolotnik—$35.90 per oz.—at Ekaterinburg; 36,700@36,800 rubles per pood—$36.02 per oz. average—at St. Petersburg.

Silver—The market closes quiet with limited transactions at 26⅝@26 11/16d. The probabilities are that no great change in the quotation will obtain the balance of the month.

Shipments of silver from London to the East, Jan. 1 to Dec. 11, as reported by Messrs. Pixley & Abell:

	1912	1913	Changes
India	£11,469,000	£9,717,000	D. £1,752,000
China	1,674,500	755,000	D. 919,500
Total	£13,143,500	£10,472,000	D. £2,671,500

Holdings of silver at Shanghai by banks and others are reported to be £5,510,000 in sycee, or currency, and £230,000 in bars, making £5,740,000, or about 51,000,000 oz. in all.

Imports of silver in France 10 months ended Oct. 31 were 315,423,000 fr.; exports, 287,605,000 fr.; excess of imports, 27,818,000 fr., against 9,369,000 fr. last year.

Imports of silver in Great Britain 11 months ended Nov. 30 were valued at £13,695,206; exports, £14,938,564; excess of exports, £1,243,358, which compares with an excess of imports of £724,240 last year.

Zinc and Lead Ore Markets

JOPLIN, MO.—Dec. 20

The highest price of zinc blende was $43 per ton, the base ranging from $38 to $40.50 per ton of 60% zinc. One company, which has purchased only calamine for over a year, came into the market for 700 tons of blende this week at a price stiff enough to take a lot of ore that current prices did not touch. Calamine is selling at $19@22 per ton of 40% zinc. The average of all grades is $37.68 per ton. Lead continues in sharp demand and as high as $55 was paid, even though buyers claim to be paying only $49 per ton of 80% metal contents. The average of all grades is $49.02 per ton.

SHIPMENTS WEEK ENDED DEC. 20

	Blende	Calamine	Lead	Value
Total this week.	10,134,080	587,420	1,751,940	$244,875
Total 51 weeks.	544,376,210	42,902,550	93,831,850	$15,030,924

Blende value, the week, $195,060; 51 weeks, $12,904,175.
Calamine value, the week, $6880; 51 weeks, $548,224.
Lead value, the week, $42,935; 51 weeks, $2,468,534.

MONTANA ZINC ORE

The production of the Butte & Superior Co. at Butte in November was 10,995 tons of concentrates, averaging 50.58% zinc.

IRON TRADE REVIEW

NEW YORK—Dec. 24

The closing week of the year shows no material change in position in the iron and steel trade. New business is rather limited, but the rate of production of the mills is variable.

Most mills are closing down this week for the usual holiday stoppage and for repairs. The time of the stop, however, will vary a good deal in individual cases. Some will close only for the actual holiday week, while others may stop for two or even three weeks, the time varying according to the work in hand in each case.

It is generally stated in the steel trade that there is "a better feeling," and while this of itself means nothing the constant reiteration may bring more business, as the unfavorable talk in the past few weeks has tended to deepen the depression. There is no heavier buying of steel products, but the fact that the close approach of the holidays has brought no decrease is in itself favorable. There is undoubtedly increased inquiry for forward delivery, and buyers are made somewhat nervous by the mills refusing to accept contracts as far ahead as contracts are usually made when the market is on the down grade or at bottom.

Reports as to railroad buying have grown still more unfavorable. It is stated that some large roads, including the New York Central Lines, have issued positive orders against all purchases except of material absolutely needed at once, and it is further reported that the Baltimore & Ohio will place no order for rails for 1914 delivery. All this, of course, is "playing politics," but to the steel industry it is painfully real while it lasts.

Pig-iron conditions are still rather mixed. Among the larger buyers there seems to be a belief that the possible bottom in prices has been nearly reached, and there is a disposition to take hold more freely. The smaller buyers, however, are still slow.

PITTSBURGH—Dec. 23

Steel-mill operations thus far this month have averaged 50% of capacity, but many mills will close the night of Dec. 24, and not open until Jan. 5, so that the month's operations will probably average only about 40%. January operations will undoubtedly be larger.

Sellers are resisting market declines more vigorously than ever. While shapes can be done rather easily at 1.20c., a decline from 1.25c., the quotation of 1.20c. is quite well adhered to on shapes, plates and bars. Tubular goods are quite firm. Wire products are shaded no more than formerly, $1.55 on nails representing the ordinary market. Sheets remain quotable at 1.90c. for black and 2.90c. for galvanized, with shading for prompt shipment, but advances for extended delivery. Tinplate specifications have considerably increased in the past fortnight and mills are running somewhat more fully.

Pig Iron—The market has been very quiet, but quotations are maintained, at least nominally. The Standard Sanitary Manufacturing Co. is inquiring for 4000 tons of foundry iron for January and February, and this inquiry will give the foundry iron market a much needed test as to actual values. We quote: Bessemer, $15; basic, $12.75; No. 2 foundry and malleable, $13.50; forge, $13.15, f.o.b. Valley furnaces, 90c. higher delivered Pittsburgh.

Ferromanganese—The market is well held in face of light buying. Mills are not contracting for next year to any extent. We quote prompt and forward, English and German, at $47, Baltimore.

Steel—The mills are taking a very decided stand on $20 for billets and $21 for sheet bars and refuse to cover consumers farther ahead than first quarter at the outside. Transactions are very light.

Iron and Steel Trade of Great Britain 11 months ended Nov. 30 as valued by the Board of Trade returns:

	Exports	Imports	Excess
Iron and steel	50,208,580	13,764,919	Exp. 36,443,661
Machinery	57,084,106	14,781,059	Exp. 42,303,047
Total	107,292,686	28,545,978	Exp. 78,746,708
Total, 1912	92,457,863	25,543,992	Exp. 66,913,781

Actual tonnage of iron and steel exported was 4,434,368 long tons in 1912, and 4,569,637 in 1913; imported, 1,812,055 tons in 1912, and 1,997,036 in 1913. Exports include value of new ships built for foreign countries.

Pig Iron Production in Germany in November is reported by the German Iron & Steel Union at 1,587,288 metric tons, being 64,159 tons less than in October. For the 11 months ended Nov. 30 the make was, in metric tons:

	1912	1913	Changes
Foundry iron	3,044,515	3,333,910	I. 289,395
Forge iron	486,091	457,162	D. 28,929
Steel pig	1,990,182	2,378,620	I. 388,438
Bessemer pig	352,026	331,878	D. 20,148
Thomas (basic) pig	10,413,732	11,180,570	I. 766,838
Total	16,286,546	17,682,140	I.1,395,594

Steel pig includes ferromanganese, spiegeleisen and all similar alloys.

IRON ORE

Receipts of Lake iron ore at Lake Michigan ports for the season of 1913 were: South Chicago, 5,572,866; Gary, 2,365,551; Indiana Harbor, 455,252; Milwaukee, 234,591; Boyne City, Mich., 45,028; East Jordan, Mich., 28,444; total, 8,701,732 tons; which is 17.5% of the total shipments.

Shipments of Wabana iron ore from Newfoundland have about ceased for the season. The total taken by Eastern furnaces this year has been about 220,000 tons, or 50,000 tons more than last year.

Imports of Iron Ore in Great Britain, 11 months ended Nov. 30, were 5,931,119 long tons in 1912, and 6,905,026 in 1913; increase, 973,907 tons. Imports of manganese ore were 346,260 tons in 1912, and 530,351 in 1913; increase, 184,091 tons.

COKE

Connellsville Coke—There has been a distinct improvement in the price situation, from the sellers' standpoint, for a contract for 12,000 tons of furnace coke for January has been closed at the $2 price, which the majority of operators are asking. There are cokes available for 1914 at less, down to $1.90 and possibly $1.85, but the assortment is limited. Prompt coke remains at $1.75, about 100 cars having been sold in the past week.

Fuel Exports of Great Britain, 11 months ended Nov. 30, in long tons:

	1912	1913	Changes
Coal	58,747,636	67,170,665	I. 8,423,029
Coke	928,612	1,115,317	I. 186,705
Briquettes	1,394,032	1,874,952	I. 480,920
Steamer coal	16,734,586	19,189,501	I. 2,454,915
Total	77,804,866	89,350,435	I. 11,545,569

Imports are small; they were 191,393 tons in 1912, and 21,435, in 1913; decrease, 169,958 tons.

Coal Production in German Empire 10 months ended Oct. 31, in metric tons:

	1912	1913	Changes
Coal mined	147,404,184	160,615,852	I. 13,211,668
Brown coal mined	67,659,847	72,323,966	I. 4,664,119
Coke made	23,838,693	26,861,798	I. 3,023,105
Briquettes made	20,171,509	22,873,670	I. 2,702,161

Of the briquettes reported this year 17,955,076 tons were made of brown coal or lignite.

German Foreign Trade in Fuel 10 months ended Oct. 31 was, in metric tons:

	Exports	Imports	Excess
Coal	28,671,267	8,839,340	Exp. 19,831,927
Brown coal	49,528	5,949,343	Imp. 5,899,815
Coke	5,543,546	514,148	Exp. 5,029,398
Briquettes	2,636,819	121,101	Exp. 2,515,718
Total	36,901,160	15,423,932	Exp. 21,477,228

Of the briquettes exported 697,593 tons were made from brown coal or lignite.

SAULT STE. MARIE CANALS

The total freight passing through the Sault Ste. Marie Canals in October was 10,919,274 short tons. For the season to Nov. 1 the totals were as follows:

	1912	1913	Changes
East-bound	48,254,518	52,681,355	I. 4,426,837
West-bound	14,414,981	18,311,213	I. 3,896,232
Total	62,669,499	70,992,568	I. 8,323,069

The total number of vessel passages this year was 20,864, showing an average cargo of 3403 tons. Mineral freights included were, in short tons except salt, which is in barrels:

	1912	1913	Changes
Coal	12,619,795	16,712,002	I. 4,092,207
Iron ore	42,177,817	44,710,520	I. 2,532,703
Pig and manufactured iron	542,460	340,970	D. 201,490
Copper	89,988	77,492	D. 12,496
Building st ne	2,282	6,181	I. 3,899
Salt, bbl	566,487	603,685	I. 37,198

Iron ore was 63% and coal 23.5% of the total traffic reported this year.

COPPER SMELTER'S REPORTS

This table is compiled from reports received from the respective companies except in the few cases noted (by asterisk) as estimated, together with the reports of the U. S. Dept of Commerce as to imported material, and in the main represents the crude copper content of blister copper, in pounds. In those cases where the copper contents of ore and matte are reported, the copper yield then is reckoned at 97%. In computing the total American supply duplications are excluded.

	July	August	September	October	November
Alaska shipments	2,705,136	1,847,785	2,261,216	1,951,883	3,391,300
Anaconda	22,100,000	22,500,000	22,600,000	18,400,000	25,250,000
Arizona, Ltd	2,600,000	1,800,000	1,800,000	3,550,000	2,800,000
Copper Queen	8,369,607	8,252,404	8,434,803	8,292,929	7,115,991
Calumet & Ariz	3,800,000	4,500,000	4,000,000	4,500,000	4,600,000
Chino	4,746,525	5,788,572	4,196,296	4,767,466	.....
Detroit	1,549,224	2,187,223	2,102,818	1,861,878	1,922,352
East Butte	1,060,257	1,162,007	1,233,018	1,040,997	1,002,190
Giroux	584,546	524,953	198,178	156,084	.....
Mason Valley	908,892	867,060	918,000	1,052,000	1,174,000
Mammoth	1,800,000	1,750,000	1,750,000	1,700,000	1,700,000
Nevada Con	5,403,919	5,989,973	4,441,671	5,898,046	5,443,647
Ohio	601,700	689,000	685,900	698,691	.....
Old Dominion	2,526,000	2,524,000	2,679,000	2,037,000	.....
Ray	4,097,000	4,269,519	4,336,434	4,725,419	.....
Shannon	880,000	1,248,000	1,232,000	1,216,000	1,110,000
South Utah	140,000	223,498	241,843	232,269	.....
Tennessee	1,247,804	1,101,019	1,309,985	1,392,162	1,688,000
United Verde*	3,000,000	3,000,000	3,000,000	3,000,000	.....
Utah Copper Co	9,849,043	10,302,251	11,463,905	9,929,478	.....
Lake Superior*	17,500,000	9,700,000	6,950,008	5,500,000	6,600,000
Non-rep. mines*	6,200,000	6,200,000	6,000,000	6,200,000	6,000,000
Total prod	101,669,653	96,427,264	91,835,075	88,102,302	.....
Imp., bars, etc	29,029,990	22,474,471	35,703,660	21,935,023	.....
Total blister	130,699,643	118,901,735	127,538,735	110,037,325	.....
Imp. ore & matte	8,527,046	9,171,351	10,800,162	5,062,015	.....
Total Amer	139,226,689	128,073,086	138,338,897	115,099,340	.....
Miami†	2,890,000	3,097,500	2,688,000	2,862,050	3,230,000
Shattuck-Arizona	1,019,388	1,001,634	1,163,237	993,224	995,429
Brit. Col. Cos.:					
British Col. Cop	618,379	647,905	621,120	688,581	.....
Granby	1,664,102	1,847,344	1,824,659	1,718,258	1,944,145
Mexican Cos.:					
Boleo†	2,240,720	2,264,640	2,369,920	2,424,800	2,315,040
Cananea	3,328,000	3,186,000	3,148,000	3,682,000	3,800,000
Moctezuma	2,693,006	3,542,047	3,024,121	3,178,136	3,517,800
Other Foreign:					
Braden, Chile	1,046,000	1,572,000	1,332,000	2,006,000	1,592,000
Cape Cop., S. Af.	.....	.....	607,040	712,320	649,600
Kyshtim, Russia	2,500,000	1,585,000	1,187,000	.....	.....
Spassky, Russia	660,800	1,048,320	1,025,920	983,360	.....
Exports from					
Chile	9,856,000	8,736,000	5,600,000	6,160,000	7,616,000
Australia	10,304,000	7,720,000	6,944,000	7,728,000	11,200,000
Arrivals–Europe‡	11,728,640	14,624,960	9,661,120	18,040,960	9,107,840

† Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister.
‡ Does not include the arrivals from the United States, Australia or Chile.

STATISTICS OF COPPER

	United States			Visible Stocks.		
Month	U.S.Refin'y Production	Deliveries, Domestic	Deliveries, for Export	United States	Europe	Total
XI, '12	134,695,400	69,369,795	55,906,550	76,744,964	103,801,600	180,546,564
XII	143,354,042	58,491,723	65,713,796	86,164,059	96,947,200	183,111,259
Year, 1912	1,581,920,287	819,665,948	746,396,452	.....	.....	.....
I, 1913.	143,479,625	65,210,030	60,383,845	105,312,582	78,491,840	183,904,422
II	130,948,881	59,676,492	72,168,523	123,198,332	77,504,000	200,702,332
III	136,251,849	76,585,471	77,699,306	122,302,890	81,244,800	203,547,690
IV	135,353,402	78,158,837	85,894,727	104,269,270	87,180,800	191,450,070
V	141,319,416	81,108,321	68,285,978	75,549,108	85,948,800	161,497,908
VI	121,860,853	68,362,571	68,067,901	67,474,225	77,235,200	144,709,425
VII	138,074,602	58,904,192	78,480,071	52,814,606	71,904,000	124,808,606
VIII	131,632,362	73,649,801	73,263,469	53,594,945	66,420,480	120,015,385
IX	131,401,229	66,836,897	73,085,275	38,314,037	63,716,800	102,030,837
X	139,070,481	68,173,720	68,123,473	29,793,094	53,625,600	83,418,692
XI	134,087,708	48,656,858	70,067,803	32,566,382	48,787,200	81,353,582
XII	.....	.....	.....	47,929,429	46,592,000	94,521,429

Note—From Jan. 1, 1913, visible supplies in Europe do not include copper afloat.

Assessments

Company	Delinq.	Sale	Amt.
Alta Cons., Utah	Dec. 8	Jan. 8	0.05
Arctic, Ida	Dec. 1	Dec. 31	.00025
Big Cottonwood, Utah	Dec. 10	Dec. 29	0.01
Bullion, Nev	Dec. 12	Dec. 30	0.02
Challenge, Nev	Dec. 16	Jan. 6	0.05
Clear Grit, Ida., postp'd	Nov. 18	Jan. 2	0.0025
Ely Consolidated, Nev	.....	Dec. 31	0.03
Empire, Ida., postp'd	Oct. 30	Jan. 2	0.005
Gold Mountain Champion, Ida	Dec. 9	Dec. 30	0.0025
Great Copper King, Ida	Nov. 29	Dec. 29	0.001
Hypotheek, Ida	Dec. 5	Jan. 5	0.006
Imlay, Nev	.....	.....	0.01
Independence, Utah	Dec. 12	Jan. 2	0.006
Leroy, Ida	Dec. 3	Jan. 3	0.002
Little North Fork, Ida	Dec. 1	Jan. 2	0.001
New Yerington, Nev	Dec. 10	Dec. 30	0.01
North Franklin, Ida., postp'd	Oct. 16	Jan. 29	0.005
O. K. Extension, Nev	Dec. 20	Jan. 8	0.0025
Overman, Nev	Dec. 10	Dec. 30	0.05
Plaza, Utah	Dec. 13	Dec. 29	0.0025
Rescue Eula, Nev	Nov. 25	Dec. 29	0.01
Robbers Roost, Calif	Dec. 5	Dec. 29	0.01
Sag. Belcher, Nev	Dec. 5	Dec. 30	0.02
Silver Star, Ida., postp'd	Nov. 22	Jan. 10	0.002
Tintic, Utah	Dec. 10	Dec. 31	0.002
Utah of Fish Springs	Dec. 15	Jan. 5	0.05
Wasatch, Utah	Dec. 22	Jan. 8	0.05

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1911	1912	1913	1911	1912	1913
January	53.795	56.260	62.938	24.865	25.887	28.983
February	52.222	59.043	61.642	24.081	27.190	28.357
March	52.745	58.375	57.870	24.324	26.875	26.669
April	53.325	59.207	59.490	24.595	27.284	27.416
May	53.308	60.880	60.361	24.583	28.038	27.825
June	53.043	61.290	58.990	24.486	28.215	27.199
July	52.630	60.654	58.721	24.286	27.919	27.074
August	52.171	61.606	59.293	24.082	28.375	27.335
September	52.440	63.078	60.640	24.209	29.088	27.986
October	53.340	63.471	60.793	24.594	29.299	28.083
November	55.719	62.792	58.995	25.649	29.012	27.263
December	54.905	63.365	.....	25.349	29.320	.....
Year	53.304	60.835	.....	24.592	28.042	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York				London Standard	
	Electrolytic		Lake			
	1912	1913	1912	1913	1912	1913
January	14.094	16.488	14.337	16.767	62.760	71.741
February	14.084	14.971	14.329	15.253	62.893	65.519
March	14.698	14.713	14.868	14.930	65.884	65.329
April	15.741	15.291	15.930	15.565	70.294	68.111
May	16.031	15.436	16.245	15.738	72.352	68.807
June	17.234	14.672	17.443	14.871	78.259	67.140
July	17.190	14.190	17.353	14.563	76.636	64.166
August	17.498	15.400	17.644	15.904	78.670	69.200
September	17.508	16.328	17.698	16.799	78.762	73.125
October	17.314	16.337	17.661	16.913	76.389	73.383
November	17.326	15.182	17.617	16.022	76.890	68.275
December	17.376	.....	17.600	.....	75.516	.....
Year	16.341	.....	16.560	.....	72.942	.....

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN

Month	New York		London	
	1912	1913	1912	1913
January	42.529	50.298	191.519	238.273
February	42.962	48.766	195.036	220.140
March	42.577	46.832	192.619	213.615
April	43.923	49.115	200.513	224.159
May	46.063	49.038	208.830	224.143
June	45.815	44.820	205.863	207.208
July	44.519	40.260	202.446	183.511
August	45.857	41.582	208.351	188.731
September	49.135	42.410	223.762	193.074
October	50.077	40.462	228.353	184.837
November	49.891	39.810	227.619	180.869
December	49.815	.....	226.875	.....
Av. year	46.096	.....	209.322	.....

New York in cents per pound; London in pounds sterling per long ton.

LEAD

Month	New York		St. Louis		London	
	1912	1913	1912	1913	1912	1913
January	4.435	4.321	4.327	4.171	15.597	17.114
February	4.026	4.325	3.946	4.175	15.738	16.550
March	4.073	4.327	4.046	4.177	15.997	15.977
April	4.200	4.381	4.118	4.242	16.331	17.597
May	4.194	4.342	4.072	4.226	16.509	18.923
June	4.392	4.325	4.321	4.190	17.588	20.226
July	4.720	4.353	4.603	4.223	18.544	20.038
August	4.569	4.624	4.452	4.550	19.655	20.406
September	5.048	4.698	4.924	4.579	22.292	20.648
October	5.071	4.402	4.894	4.253	20.630	20.302
November	4.615	4.293	4.463	4.146	18.193	19.334
December	4.303	.....	4.152	.....	18.069	.....
Year	4.471	.....	4.360	.....	17.929	.....

New York and St. Louis cents per pound. London, pounds sterling per long ton.

SPELTER

Month	New York		St. Louis		London	
	1912	1913	1912	1913	1912	1913
January	6.442	6.931	6.292	6.854	26.642	26.114
February	6.499	6.239	6.349	6.089	26.661	25.338
March	6.626	6.078	6.476	5.926	26.048	24.605
April	6.633	5.641	6.483	5.491	25.644	25.313
May	6.679	5.406	6.529	5.256	25.790	24.583
June	6.877	5.124	6.727	4.974	25.763	22.143
July	7.116	5.278	6.966	5.128	26.174	20.592
August	7.028	5.658	6.878	5.508	26.443	20.706
September	7.454	5.694	7.313	5.544	27.048	21.148
October	7.426	5.340	7.276	5.188	27.543	20.614
November	7.371	5.229	7.221	5.083	26.804	20.581
December	7.162	.....	7.081	.....	26.494	.....
Year	6.943	.....	6.799	.....	26.421	.....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1912	1913	1912	1913	1912	1913
January	$15.12	$18.15	$13.32	$17.35	$14.00	$18.59
February	15.08	18.15	13.28	17.22	14.01	18.13
March	14.95	18.15	13.66	16.96	14.10	17.53
April	15.13	17.90	13.90	16.71	14.15	16.40
May	15.14	17.68	13.90	15.80	14.12	15.40
June	15.15	17.14	14.11	15.40	14.22	15.10
July	15.15	16.31	14.38	15.13	14.38	14.74
August	15.43	16.63	14.90	15.00	14.85	14.88
September	16.86	16.65	16.03	15.04	15.63	14.93
October	17.90	16.60	17.18	14.61	17.22	14.80
November	18.07	16.03	17.09	13.91	18.00	14.40
December	18.15	.....	17.45	.....	18.73	.....
Year	$16.01	.....	$14.93	.....	$15.28	.....

STOCK QUOTATIONS

COLO. SPRINGS Dec. 22

Name of Comp.	Bid.
Acacia	.02¾
Crippie Cr'k Con.	.09
C. K. & N.	.07½
Doctor Jack Pot	.06½
Elkton Con.	.51
El Paso	2.40
Findlay	.01
Gold Dollar	.06½
Gold Sovereign	.02
Golden Cycle	2.00
Isabella	.10
Jack Pot	.05
Jennie Sample	.05
Jerry Johnson	.03½
Lexington	.03
Old Gold	.01
Mary McKinney	.57
Pharmacist	.01
Portland	1.00
Vindicator	.82

SALT LAKE Dec. 22

Name of Comp.	Bid.
Beck Tunnel	.04½
Black Jack	.06½
Cedar Talisman	.00½
Colorado Mining	.11
Crown Point	.00½
Daly-Judge	5.60
Gold Chain	.14
Grand Central	.53
Iron Blossom	1.15
Little Bell	.10
Lower Mammoth	.01½
Mason Valley	3.00
May Day	.05½
Nevada Hills	.40
New York	.00½
Prince Con.	.18
Silver King Coal'n	3.15
Sioux Con.	.01½
Uncle Sam	.03½
Yankee	.04

TORONTO Dec. 22

Name of Comp.	Bid.	Name of Comp.	Bid.
Bailey	.05	Foley O'Brien	.16
Coniagas	7.12½	Hollinger	16.87½
T. & Hudson Bay	68.00	Imperial	.01½
Timiskaming	.13	Jupiter	.06
Wettlaufer-Lor.	.07	Pearl Lake	.09½
Apex	.01	Porcu. Gold	.10½
Big Dome	14.75	Preston E. D.	.01½
Crown Chartered	.00½	Rea	.10
Dobie	‡.10	Swastika	.04½
Dome Exten	.06	West Dome	.08

SAN FRANCISCO Dec. 22

Name of Comp.	Bid	Name of Comp.	Bid
Comstock Stocks		Misc. Nev. & Cal.	
Alta	.06	Belmont	7.00
Belcher	.48	Jim Butler	.69
Best & Belcher	.04	MacNamara	.07
Caledonia	1.55	Midway	.36
Challenge Con.	.02	Mont.-Tonopah	.95
Chollar	.02	North Star	.38
Confidence	‡.38	West End Con.	1.22½
Con. Virginia	.13	Atlanta	.11
Crown Point	.39	Booth	.01
Gould & Curry	.03	C.O.D. Con.	.02
Hale & Norcross	.07	Comb. Frac.	.05
Mexican	1.15	Jumbo Extension	.10
Occidental	.70	Pitts.-Silver Peak	.35
Ophir	.18	Round Mountain	.03
Overman	.34	Sandstorm Kendall	.06
Potosi	.03	Silver Pick	.03
Savage	.11	Argonaut	2.50
Sierra Nevada	.11	Bunker Hill	1.50
Union Con.	.12	Central Eureka	.42
Yellow Jacket	.38	So. Eureka	2.00

N. Y. EXCH. Dec. 22

Name of Comp.	Cig.
Amalgamated	71¼
Am. Agri. Chem.	43
Am.Sm.&Ref.,com.	64
Am. Sm. & Ref., pf.	98
Am. Sm. Sec., pf. B	80½
Anaconda	35
Batopilas Min.	⅛
Bethlehem Steel,pf.	68¼
Chino	38½
Federal M. & S., pf.	32½
GreatNor.,ore,ctf.	34
Guggen. Exp.	45¼
Homestake	114
Inspiration Con.	14½
Miami Copper	21¾
Nat'l Lead, com.	44
National Lead, pf.	103½
Nev. Consol.	15
Phelps Dodge	183
Pittsburg Coal, pf.	87½
Quicksilver, pf.	2¼
Ray Con.	18
Republic I&S,com.	20¼
Republic I&S, pf.	81½
SlossSheffi'd,com.	28½
Sloss Sheffield, pf.	86
Tennessee Copper	30½
Utah Copper	48¼
U. S. Steel, com.	59½
U. S. Steel, pf.	105½
Va.Car.Chem.,pf.	96½

N. Y. CURB Dec. 22

Name of Comp.	Cig.
Ariz. Belmont.	.03½
Barnes King	1⅛
Beaver Con.	.32
Big Four	‡.08
Boston Montana	5½
Braden Copper	6¾
B. C. Copper	2⅜
Buffalo Mines	1 3/16
Can. G. & S.	.12
Caribou	.67
Con. Ariz. Sm.	3/16
Coppermines Cons.	2¼
Davis-Daly	1⅛
Diam'field-Daisy	‡.03
Ely Con.	.01½
Florence	.22
Gold Hill Con.	.18
Goldfield Con.	1⅜
Greene Cananea	29
Greenwater	.05½
Internat. S. & R.	‡115
Kerr Lake	4 7/16
La Rose	2
McKinley-Dar-Sa.	1
Min. Co. of A. new	2 1/16
New Utah Bingham	.41
Nipissing Mines	7¼
Ohio Copper	⅜
Puebla S. & R.	2¼
South Utah M&S.	3/16
Stand'd Oil of N.J.	399
Stewart	1½
Tonopah	6 9/16
Tonopah Ex.	1½
Tonopah Merger	.51
Tri-Bullion	⅛
Tularosa	7/16
Union Mines	‡.08
United Cop., pfd.	3
Yukon Gold	2

LONDON Dec. 15

Name of Comp.	Cig.
Camp Bird	£0 13s 9d
El Oro	0 15 0
Esperanza	0 18 9
Mexico Mines	5 7 6
Oroville	0 11 0
Santa Gert'dis.	0 17 6
Stratton's	0 0 6
Tomboy	1 7 6

BOSTON EXCH Dec. 22

Name of Comp.	Cig.
Adventure	1½
Ahmeek	252
Alaska Gold M.	21⅛
Algomah	.85
Allouez	34
Am. Zinc	18½
Ariz. Com., ctfs.	4⅛
Bonanza	.62
Boston & Corbin	‡.50
Butte & Balak	3½
Calumet & Ariz.	63½
Calumet & Hecla	410
Centennial	14
Cliff	‡1
Copper Range	34
Daly West	2½
East Butte	11
Franklin	2¾
Granby	72
Hancock	15
Hedley Gold	‡29¾
Helvetia	.25
Indiana	4½
Island Cr'k, com	46
Island Cr'k, pfd.	83½
Isle Royale	19
Keweenaw	2½
Lake	7
La Salle	3½
Mass	2
Michigan	.50
Mohawk	42
New Arcadian	1½
New Idria Quick	2⅞
North Butte	28½
North Lake	‡1½
Ojibway	.75
Old Dominion	49
Osceola	72
Quincy	56
Shannon	6
Shattuck-Ariz.	26½
Superior	25½
Superior & Bost.	2¾
Tamarack	29
Trinity	4
Tuolumne	.57
U. S. Smelting	40
U. S. Smelt'g, pf.	48
Utah Apex	1⅜
Utah Con.	8½
Victoria	1
Winona	1⅛
Wolverine	42½
Wyandot	.50

BOSTON CURB Dec. 22

Name of Comp.	Bid
Bingham Mines	4¾
Boston Ely	.40
Butte&Lon'nDev.	.31
Cactus	.01½
Calaveras	1¾
Chief Cons.	1 1/16
Corbin	1¾
Cortez	.20
Crown Reserve	1¾
Eagle & Blue Bell	.99
First Nat. Cop.	2¾
Houghton Copper	2¾
Majestic	.23
Mexican Metals	.38
Moneta Porc.	‡.01
Nevada-Douglas	1⅛
New Baltic	.50
Oneco	.80
Raven Copper	.12
Rhode Island Coal	.01
Smokey Dev.	.50
So. Lake	4¾
S. W. Miami	1
Tonopah Victor	.26
Trethewey	.25
United Verde Ext.	.45

‡Last Quotation.

The Engineering and Mining Journal

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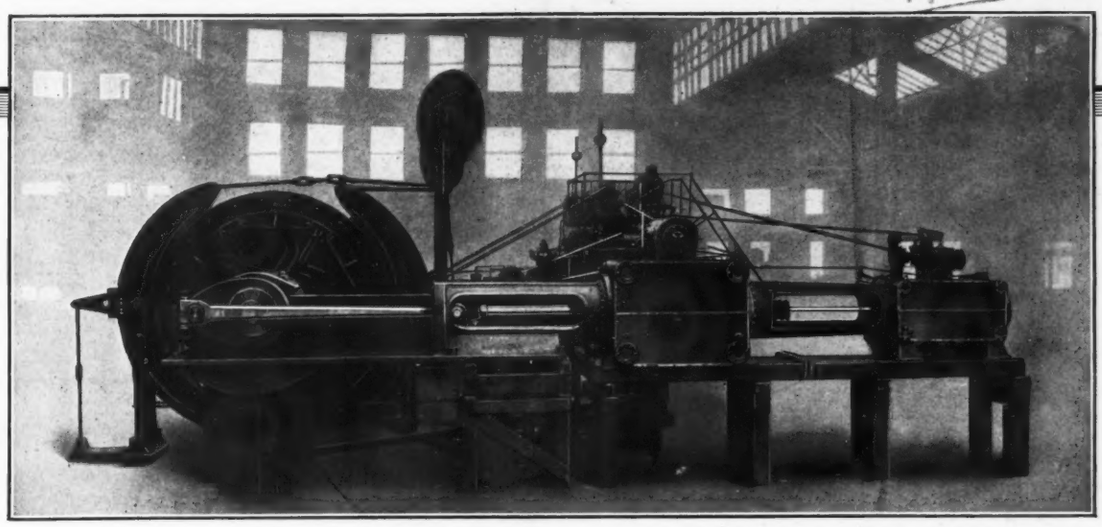

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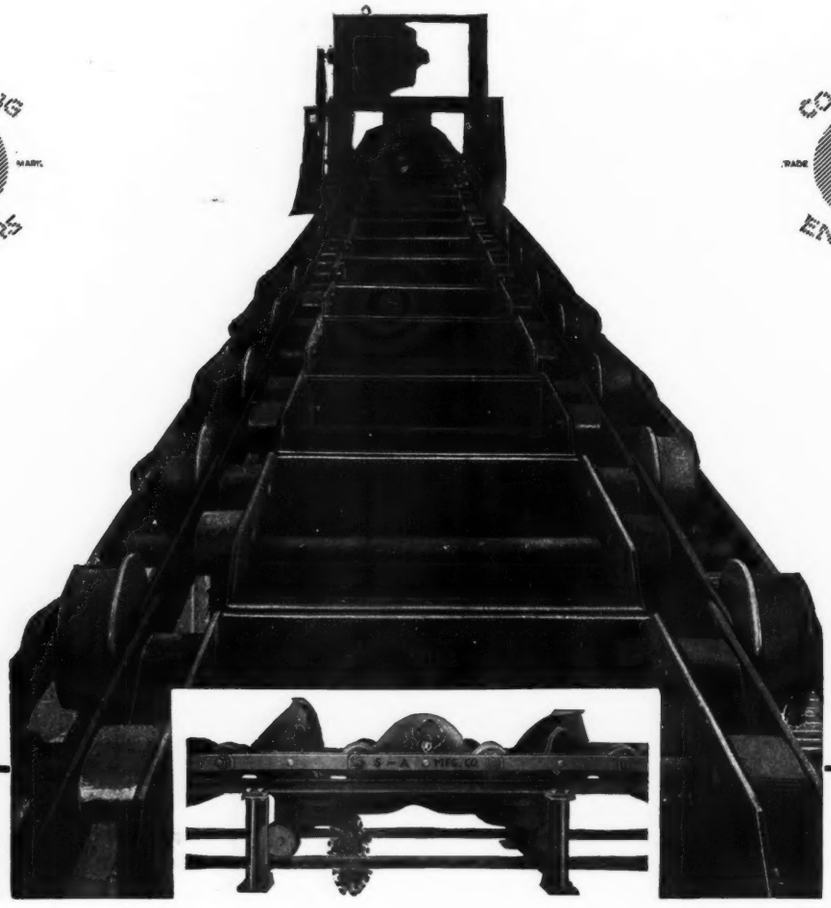

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CIRCULATION OF THIS ISSUE 10,100

None sent free regularly, no returns from news companies, no back numbers

GREETINGS

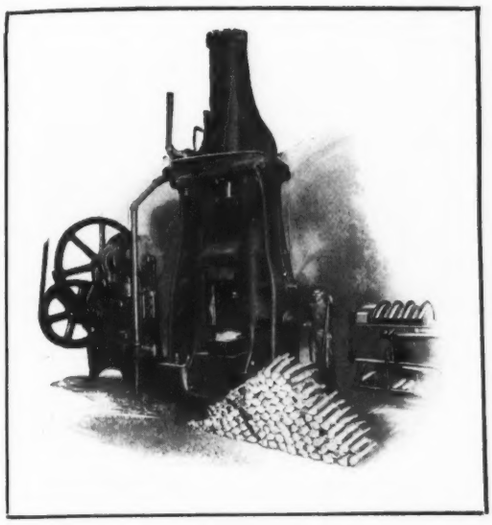
The old year's winging to its close
We're almost ready for the New,
The old year had its joys and woes
But when we pass them in review
We find the skies were often blue
In spite of clouds that we recall,
And now the year is almost through,
Here's "Happy New Year" to you all!

We've preached to you in plodding prose
Of Advertising, false and true,
We've marshalled facts in rows and rows
And written sermons not a few,
Perhaps you've muttered, "That'll do,"
Or softly murmured, "Hire a hall!"
—Ah well, the year is almost through,
Here's "Happy New Year" to you all!

We've done our durndest, heaven knows,
To help ourselves by helping you,
And if we've trod on people's toes
Or thrown some tempers all askew
We're sorry—and that's honest, too!
We would be friends with great and small,
And now the year is almost through,
Here's "Happy New Year" to you all!

ENVOI

Kris Kringle's merry spirit
Still holds the wide, wide world in thrall;
So, with the old year almost through,
Here's "Happy New Year" to you all!



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On most rock drills these parts are **cast** and therefore subject to crystallization—

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The lower illustration shows bars of steel of proper physical and chemical analysis being heated to proper forging heat. The upper illustration shows our 4000 lb. steam drop hammer which pounds the bar between two dies to give it the proper shape. By the time the metal emerges from the other process it has been made well nigh unbreakable.

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placed underground **stay** underground. The repairs, few and far between, can be effected almost instantly with a small wrench, right on the job.

And the most vital part of the drill—the valve—is on the **outside** where it can be overhauled in a jiffy when necessary.

In most machines the stretching of side rods or bolts lets the cylinder loosen a trifle, destroying the air cushion, and the valve and valve chest suffer by being struck by the piston,—on "Cleveland" Stopers, the valve chest being on the *outside*, even if the piston should hit the back, no harm would be done.

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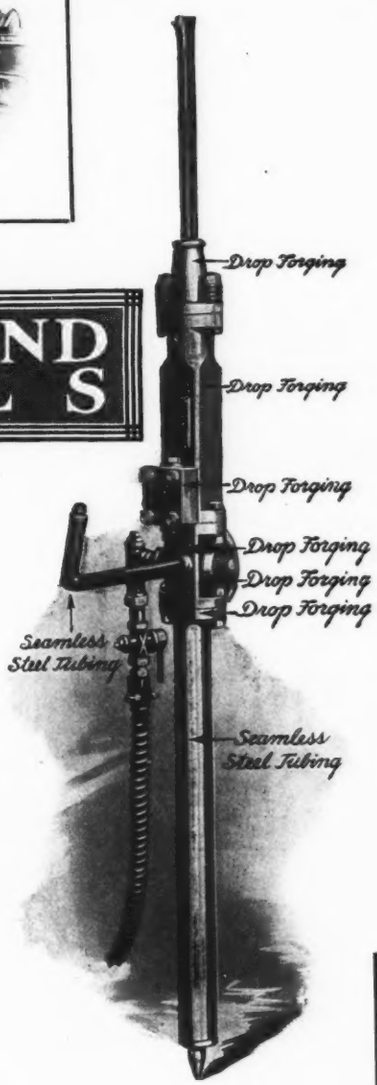

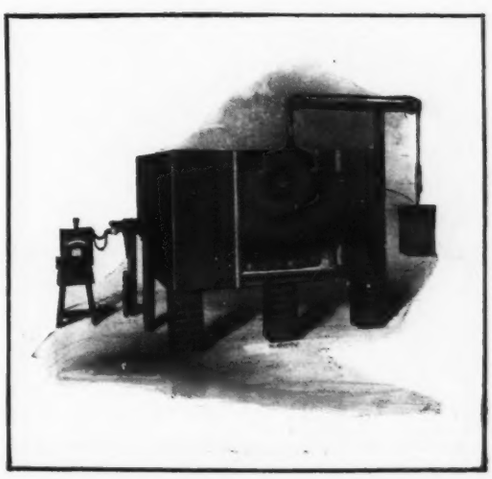

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LEADVILLE DRILL COLUMN HOIST

As Portable as Your Rock Drills

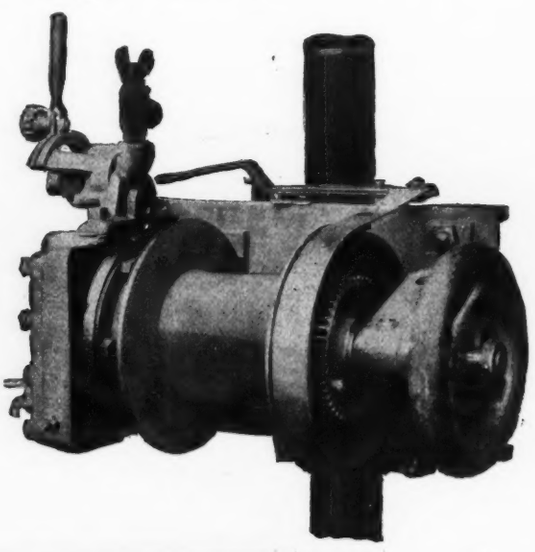
HANDY, POWERFUL, INEXPENSIVE

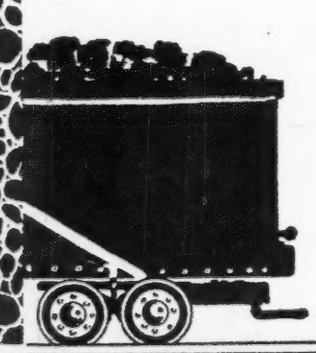
Could not be simpler—

Could not do better in reducing light hoisting and hauling costs in any part of your mine.

Takes the place of the big cumbersome hoists.

OPERATED BY AIR





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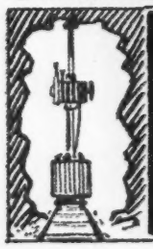

Hendrie & Bolthoff MFG. and SUPPLY CO. DENVER, COLORADO

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What Hoist

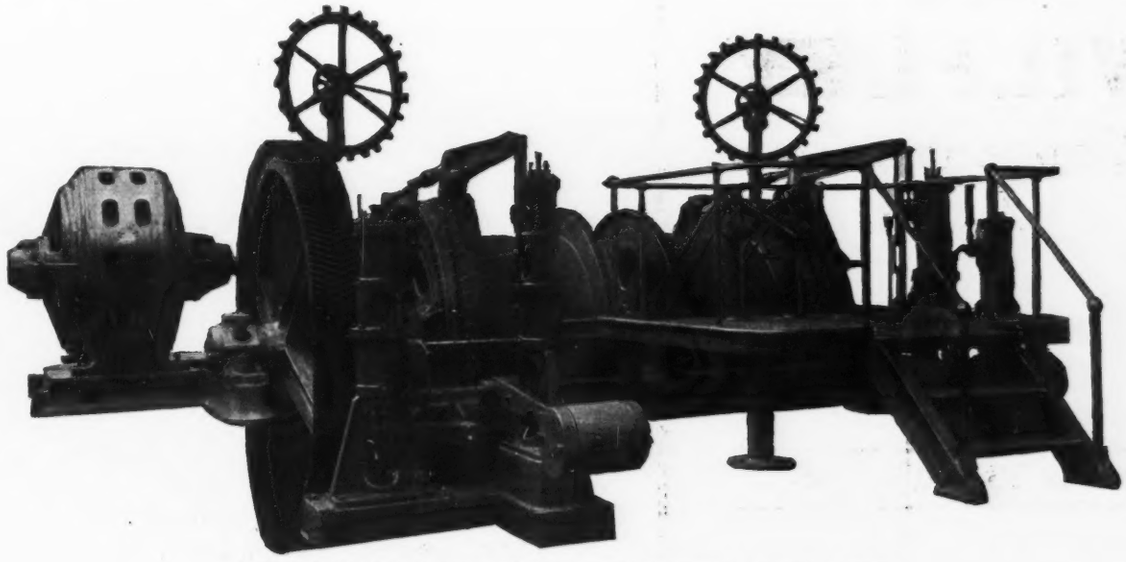
says the mine manager

Naturally, the very best. For my lifts are longest; I must work my hoists to their full capacity seven days in the week; and I'm a long way from hoist headquarters.

How can I make sure of getting the best hoist? By buying from the hoist maker with the widest and most dependable engineering knowledge and who, at the same time, has the plant facilities for making the hoist I need.

Wellman-Seaver-Morgan Hoists

Each hoist designed for its particular work by an Engineering Staff with more than 40 years of hoist-making experience behind it.
Each hoist made in a plant absolutely second to none—a plant equipped to cast and finish any hoist no matter how large or how intricate.
Just write us direct—get the complete story—and all for yourself.



A. W. S. M. Hoist built for the Halifax, Tonopah Mining Co., Tonopah, Nevada.

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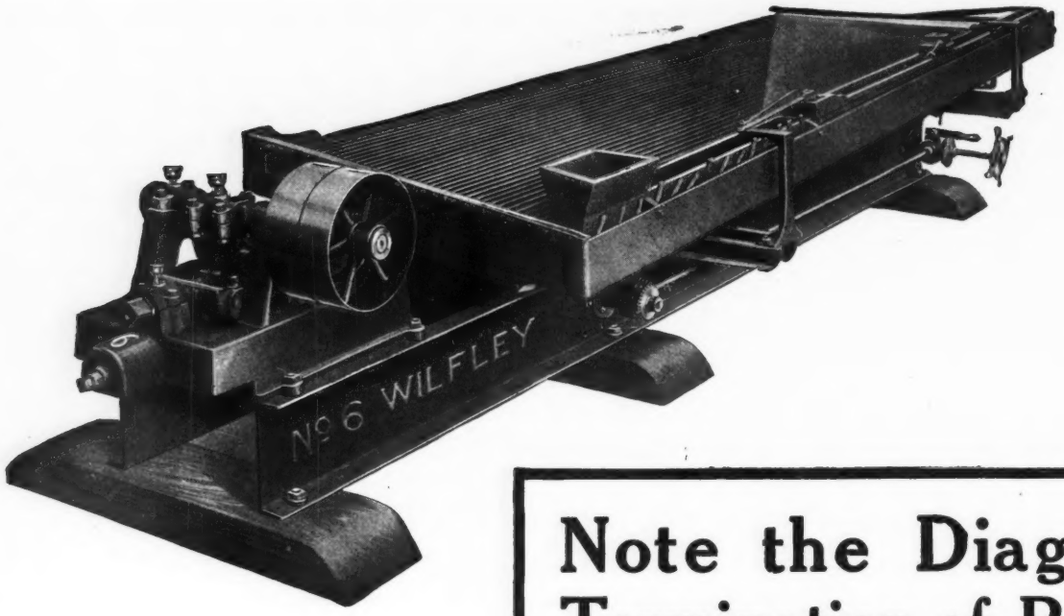


The WILFLEY Concentrating Table

Over 18,000 in Use

Note the Diagonal Termination of Riffles

That is the basic principle of successful concentration, without which all concentrators fail.

And it is an exclusive feature of the Wilfley—one reason for its tremendous success, and why there are more than 10 times as many Wilfleys in use as all other tables combined.

To you it is worth the price of a Wilfley to get it. And when you buy your Wilfley, you can do so with the assurance that no other table can give you the capacity, or the lasting service.

Carried in stock at all our stores—ready for immediate delivery.

Write to the store nearest you for prices, particulars, etc.

The Mine and Smelter Supply Co.
DENVER — SALT LAKE CITY — EL PASO — MEXICO CITY
New York Office, 42 Broadway

Sole Owners and Manufacturers of the Wilfley Concentrator

OVOCA CLASSIFIER

Is Now on the Market

Separates Instantly

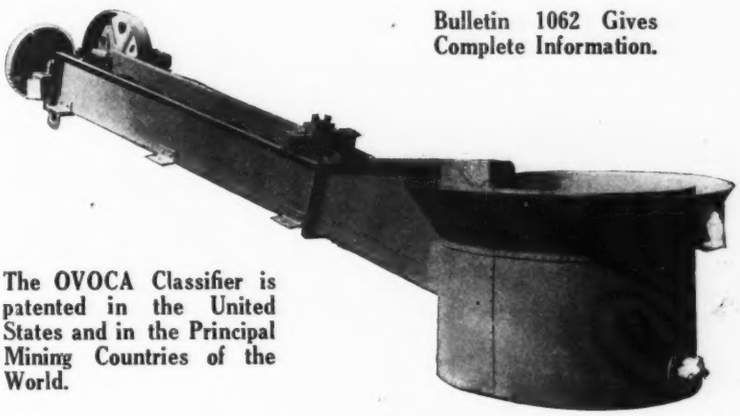
Slimes of Desired Grading from Sand.
Flotation Concentrates from Solution.
Water from Concentrates or Tailings.

The Ovoca Classifier was developed by Philip Argall at Stratton's Independence mill, Victor, Colorado, where these machines were thoroughly tried out for several years before being placed on the market.

Several Ovoca Classifiers are in operation at the Ozark Smelting and Mining Company's plant, Magdalena, New Mexico. Two of the latest design at Stratton's Independence Mill, Victor, (in addition to the ones used in developing the machines). One at the Tri-Bullion Mill, Kelly, New Mexico, and one at the American-Boston Mill, Diorite, Michigan.

Eighteen Ovoca Classifiers are in successful operation in the United States, with a service varying from four years down to something less than one year; while several are being installed in foreign countries.

Bulletin 1062 Gives Complete Information.



The OVOCA Classifier is patented in the United States and in the Principal Mining Countries of the World.

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Mine Cages
Stamp Mills
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Automatic Samplers
Sample Grinders
Ore Buckets

The Denver Engineering Works Company

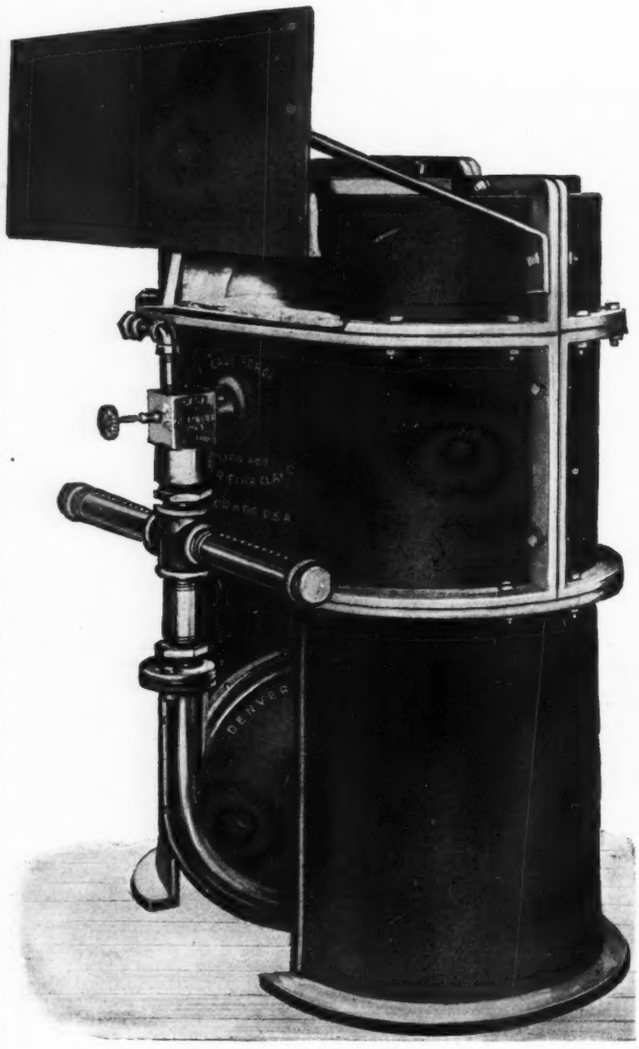
Denver, Colorado, U. S. A.

Exclusive manufacturer and sales agent for the Ovoca Classifier for United States and Mexico.

132

Do you object to saving 20 to 40% in fuel

For work accomplished and number of heat units produced?



Probably not seriously.

Then investigate the Case Low Pressure Oil Forge. Past experiences prove that our system of burning fuel oil reduces costs —20 to 40% saving in fuel.

CASE

Low Pressure Oil Forge

Patented Nov. 4th, 1913

For heating drill steel this forge possesses many powerful advantages.

Drill heated in the Case Low Pressure Oil Forge will not scale and the steel is always in plain sight. No danger of sulphurized or oxidized steel and the drills hold their edge for a longer time. Noise and smoke are practically eliminated.

Let us give you reasons and proof that fuel oil, when burned in the Case Low Pressure Oil Forge, is more economical than coal or coke and gives better results.

Write for Catalog and Full Particulars.

The Denver Fire Clay Company

Established 1876 Incorporated 1880

Denver, Colorado, U. S. A.

Manufacturers Of Assayers' And Chemists' Supplies

Largest Manufacturers Of Furnaces In The World

REPAIRS MADE WHILE UNDER WORKING PRESSURE

No need to shut down your plant. Ferrobestic can be applied while the boilers are under full pressure.

Read what the Chief Engineer of the S. S. Brazos, New York and Porto Rico S. S. Company, New York, says about Ferrobestic.

June 23, 1913

Dear Sir:—

I have found the test pieces which you put on our boilers, July, 1912, just as sound as when applied. Not only does it keep the iron clean and free from corrosion, but I find it very handy for patching where the other covering is broken off, and this can be done by our own fireman. I would like to see the whole eight boilers treated with the compound. I use it every place I can.

Yours truly,

(Signed) R. P. Browne.

FERROBESTIC

is a liquid binder for asbestos and metal. It is applied with a brush the same as ordinary paint and works perfectly on the hottest surfaces. As it dries instantly, one coat can follow the other without loss of time. One gallon is sufficient to give three complete coats to 115 square feet of surface and as there is no re-inforcing or binding material needed, one man can accomplish as much in one hour using Ferrobestic as would require almost a whole day working under the old-fashioned methods.

Jarring, vibration and water hammer or any condition to which boilers and steam pipes are subjected will not affect the insulation put on over a foundation of Ferrobestic.

Sample Free on Request

If you have an undesirable boiler to lag or a section of pipe that you have trouble keeping covered, this free sample will help you solve the problem. The attached coupon is for your convenience—use it to-day and judge the merits of our claims for yourself.

Ferrobestic is guaranteed satisfactory to the user—try it at our expense.

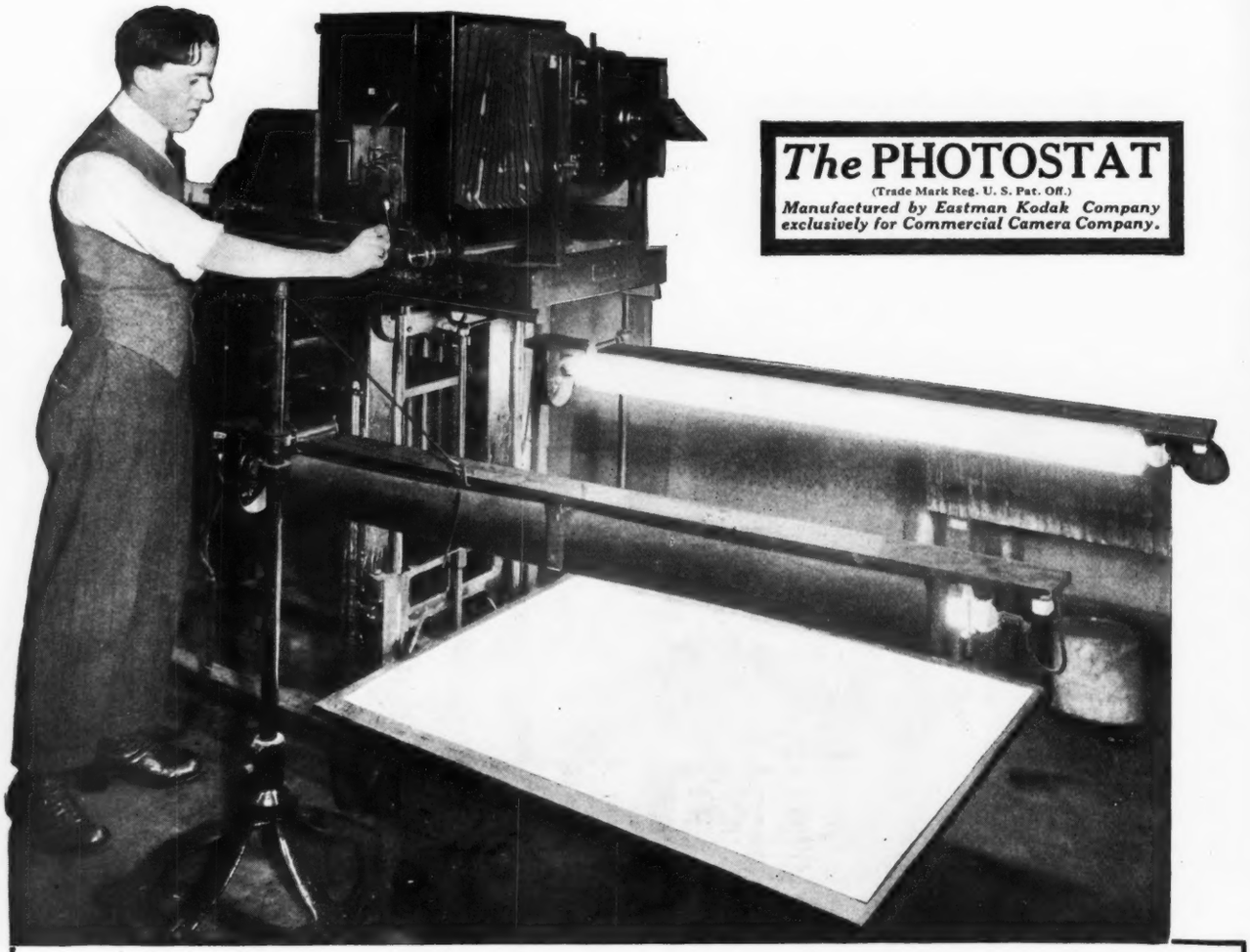
John Simmons Company

103 Centre Street, New York

JOHN SIMMONS COMPANY, 103 CENTRE STREET, NEW YORK
I will thoroughly test a sample of Ferrobestic if sent FREE OF CHARGE

Name of Company.....
Address.....
Engineer.....
No. of Boilers.....
Type.....

51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(Trade Mark Reg. U. S. Pat. Off.)
Manufactured by Eastman Kodak Company
exclusively for Commercial Camera Company.

The Modern Way—Photostat It

Send us a sample of the class of work you have, large or small, and we will Photostat it for you and give you full details as to cost, send our representative to advise you as to your particular problem, or direct you to the nearest Photostat in operation.

The modern way because it is the quickest way—the cheapest way in both time and money. The installation of the Photostat in your mines means the saving of money on all map, plan and reproduction work. It means you can reduce the size of your drafting department and **increase** its effectiveness.

The copy is made by photographing directly upon durable, sensitized paper, without the necessity of preparing a transparent negative.

The copy is developed and permanently fixed in the PHOTOSTAT itself. No dark room is required. When washed and dried the copy is all ready for use.

The operation is extremely simple. Perfect results are obtained without expert knowledge. Let us tell you more. **Write today.**

Commercial Camera Co., 343 State St., Rochester, N. Y.

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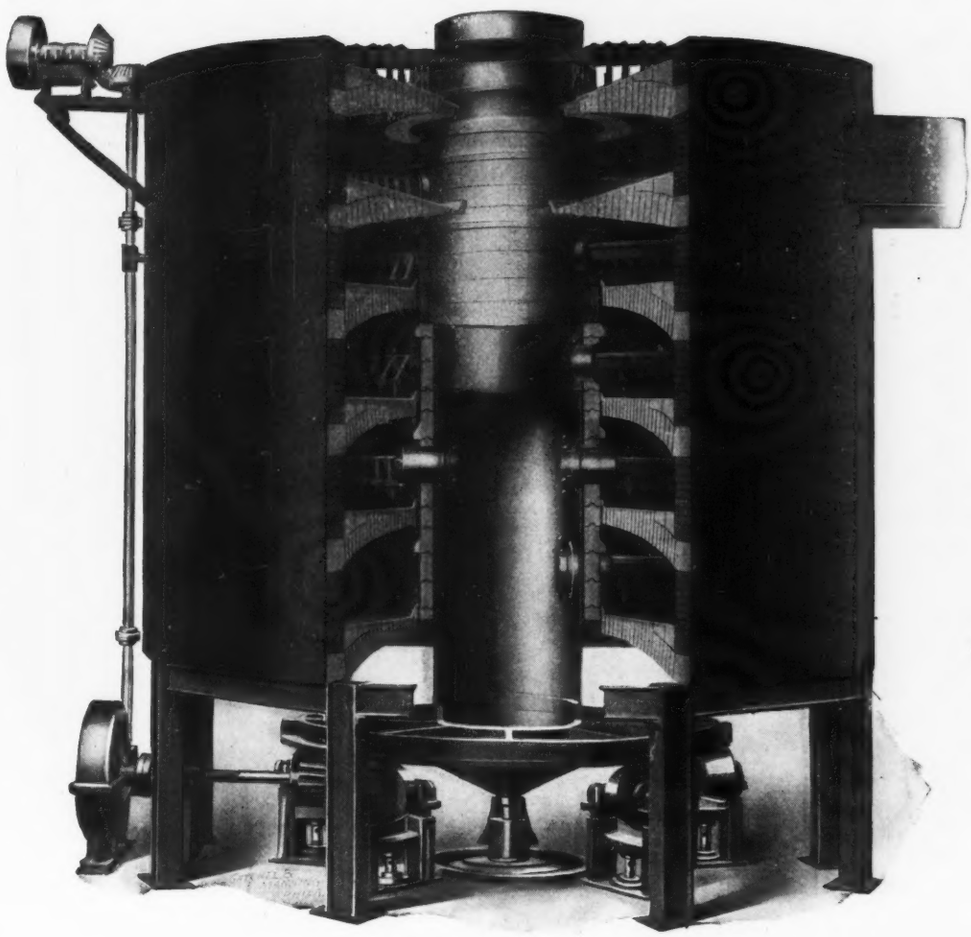
The Wedge Mechanical Furnace

Patented



Roasting Lead Matte Without Fuel

The above multiple-hearth furnace, with special detail for perfect temperature regulation, is successfully roasting lead matte without the use of fuel, showing a decided reduction in operating costs.

Write us stating analysis of ore, concentrates, mixture or material you desire to roast, characteristics and physical condition of same, number of tons to be treated per twenty-four hours, and results you desire in the calcine.

Wedge Mechanical Furnace Company

115 Chestnut Street, Philadelphia

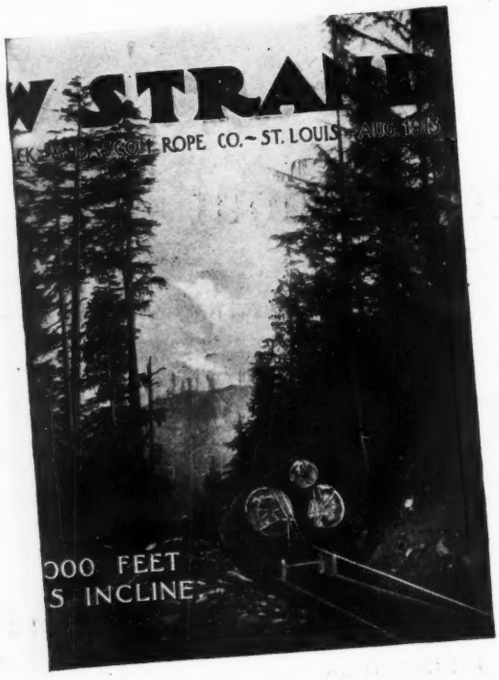
It Gets Red Hot Every 7 Minutes But YELLOW STRAND ROPE Stands the Strain

The Kansas Zinc Company has three large roasting kilns at Altoona, Kan., through which great revolving "rabbles" are drawn back and forth every six or seven minutes by YELLOW STRAND ROPE.
The temperature of the kilns averages 1350 degrees Fahrenheit. The Yellow Strand operates through a channel only 30 inches below the kiln bed and often gets red hot.

Service like this would quickly destroy ordinary wire rope—but Yellow Strand stands up and lasts under this terrific strain.
Yellow Strand retains its strength and elasticity under severe conditions. It is unsurpassed in safety and economy for every class of mining work.

Write for catalog No. 8.

This Monthly Magazine FREE



Send us your name on your business letter-head and we will put you on our FREE mailing list—for this splendidly illustrated magazine devoted to the interests of all wire rope users. Better do it today and start with the December number.

Broderick & Bascom Rope Co.
809 N. Main Street, St. Louis, Mo.
Branches—Seattle, New York

"NATIONAL" BECAUSE BALANCES "NATIONAL" THEREFORE

NATIONAL
NATIONAL
1. "NATIONAL" Pipe is more uniform in composition.
2. "NATIONAL" Pipe contains no "weak spots."
3. In "NATIONAL" Pipe manufacture the human element is almost entirely eliminated and "NATIONAL" Pipe is made in larger unit quantities.
4. Uniform metal tends to lessen corrosion especially in the form of pitting; "NATIONAL" Pipe receives special Spellerizing process in manufacture.
5. "NATIONAL" Pipe is made entirely in one mill from ore to finished product.
6. "NATIONAL" Pipe is uniform in chemical and physical properties.
7. "NATIONAL" Pipe in sizes 4 inches and smaller receives the Spellerizing process.
8. "NATIONAL" Pipe is tested with internal hydrostatic pressure.
9. "NATIONAL" Pipe is made only full standard weight.
10. "NATIONAL" Pipe is marked with the word "NATIONAL."
NATIONAL
1. THEREFORE—is stronger and more ductile than ordinary pipe.
2. THEREFORE—gives a cleaner cut and stronger thread than ordinary pipe.
3. THEREFORE—costs less than wrought iron pipe.
4. THEREFORE—is at least as durable as wrought iron pipe (in many instances it has been found to be more durable.)
5. THEREFORE—is uniform in quality from year to year.
6. THEREFORE—uniformly good results are obtained in actual service.
7. THEREFORE—has additional protection against corrosion.
8. THEREFORE—is suitable for severe service.
9. THEREFORE—no trouble can ensue from unsuitable light-weight pipe.
10. THEREFORE—substitution of light-weight pipe is impossible.
NATIONAL

Ask for N. T. C. Bulletin No. 12A. This bulletin has recently been enlarged and revised and contains a summary of information about "NATIONAL" Pipe. When you read it you will keep it on file for permanent use. It's free.

MARKING

¶ To readily identify "NATIONAL" material and as protection to manufacturer and consumer alike, the practice of National Tube Company is to roll in raised letters of good size on each few feet of every length of welded pipe the name "NATIONAL" (except on the smaller butt-weld sizes, on which this is not mechanically feasible; on the smaller butt-weld sizes the name "NATIONAL" appears on the metal tag attached to each bundle of pipe).

Name Rolled in Raised Letters on National Tube Company Pipe

¶ When writing specifications or ordering tubular goods, always specify "NATIONAL" Pipe, and identify as indicated. ¶ In addition, all sizes of "NATIONAL" welded pipe, below four or five inches are subjected to a roll-knobbling process known as Spellerizing to lessen the tendency to corrosion, especially in the form of pitting. This Spellerizing process is peculiar to "NATIONAL" pipe, to which process the National Tube Company has exclusive rights.

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DISTRICT SALES OFFICES:

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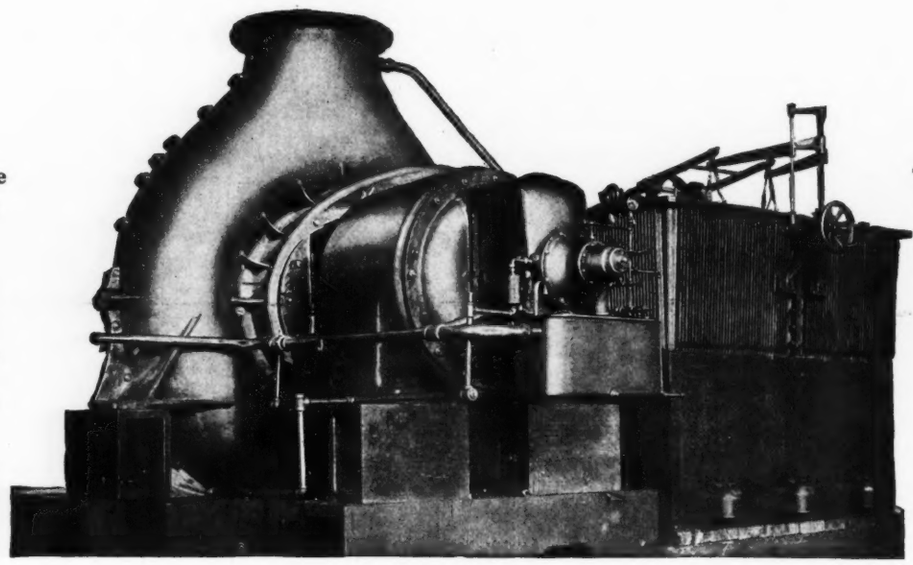
The Guarantee of Excellence

on Goods Electrical



The Guarantee of Excellence

on Goods Electrical

G-E Centrifugal Air Compressor, Driven by 450 H. P., 3-Phase, 60 Cycle, 6600-Volt Induction Motor in Boston and Montana Reduction Dept. of Anaconda Copper Co., Great Falls, Montana.

Automatically Regulated Air Volume for Any Charge

Simply set the constant volume governor of a G-E centrifugal air compressor to the value necessary for the charge fed the copper blast furnace. Thereafter, the volume of air delivered is automatically kept constant and is not dependent upon the judgment of furnace operator or the resistance of charge.

These centrifugal air compressors are extremely simple—just one moving part and a housing.

All wear is confined to three bearings. There are no other rubbing parts so the high initial efficiency of G-E centrifugal air compressors is maintained indefinitely. The clearances between moving and stationary parts being in tenths of an inch rather than hundredths no wear from touching is possible.

G-E Centrifugal air compressors occupy a very small floor space—this reduces cost of foundations and housing—and are light in weight—saving in freight, handling and installation costs.

All the advantages of G-E centrifugal air compressors for copper blast furnaces are found in the multi-stage machines for copper converters with the single exception of the constant volume governor. This is unnecessary as the machines have the inherent characteristic of regulating themselves for practically constant pressure over a wide range of load.

These compressors are driven by either a Curtis Steam turbine or a 60 cycle induction motor.

G-E centrifugal air compressors are rated in free air actually delivered. They should not be confused with displacement ratings of displacement machines.

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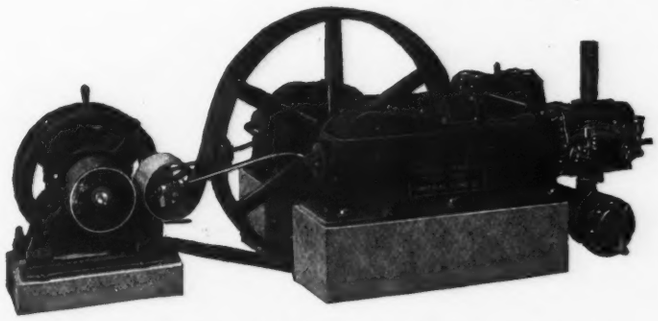
For Texas, Oklahoma and Arizona business refer to Southwest General Electric Co., (formerly Hobson Electric Co.)—Dallas, El Paso, Houston and Oklahoma City. For Canadian business refer to Canadian General Electric Company, L't'd, Toronto, Ont. 4514



The "Imperial" Short Belt Drive Motor Unit compares favorably as to economy with the direct-connected motor unit but is lower in first cost because it uses standard motors.

Enclosed Construction in Air Compressors

No one would think of mixing sand or grit with the oil for his compressor. Yet the average air compressor without provision for excluding dirt is subject to just this sort of abuse.

Result—excessive power consumption, excessive friction and wear, leakage, loss of adjustment and sacrifice of efficiency.

Enclosed, dust-proof construction is a standard and distinctive feature of all types of Ingersoll-Rand Compressors.

Moreover, this protection is secured without any sacrifice of the "get-at-able" convenience so essential to successful operation; for the covers are easily removed for inspection and adjustment, without loosening any bolts.

Ingersoll-Rand enclosed construction keeps the dirt out and keeps the oil in. This means not only the most efficient and economical lubrication, but also the utmost cleanliness of machine and surroundings.

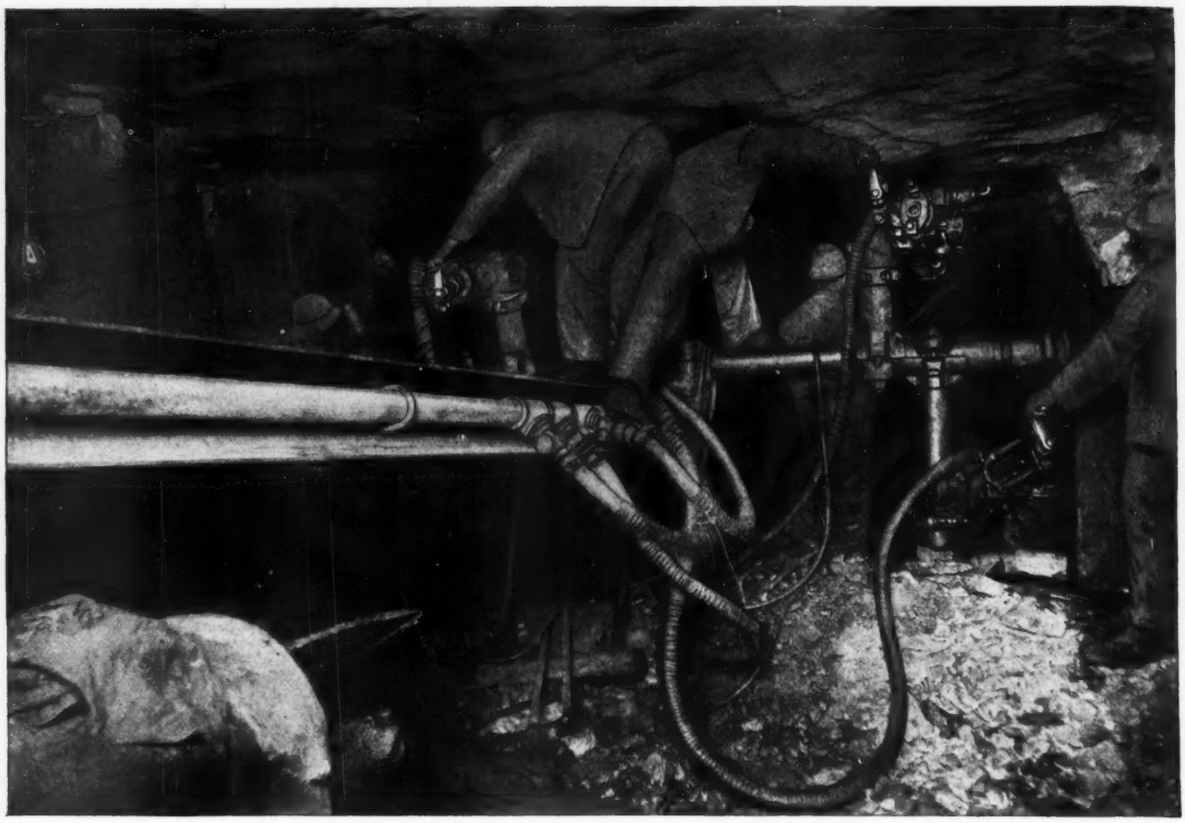
An unenclosed air compressor is more than an anomaly, today—it is an extravagance.

NEW YORK **INGERSOLL-RAND CO.** LONDON

Offices the World Over

Compressors **Rock Drills** **Stope Drills** **Plug Drills** **Core Drills**

C-67



Holed Through!

On December 10, the Mount Royal Tunnel, at Montreal, 3¼ miles long, was holed through, after 15 months' constant work.

A world's record for hard rock tunneling was set in this work, last May, when 810 feet of single heading were driven in 31 working days, with

Sullivan Water Drills

Since May, more than 6000 feet of tunnel have been driven, in two headings, or an average advance of over 480 feet per heading per month.

Sullivan Rock Drills have been used exclusively during all of this work. Their unusual speed and freedom from drill troubles, coupled with the efficient organization and scientific planning of the engineers, are responsible for this remarkable tunnel performance.

A report on the Mount Royal Tunnel will be given in *Mine and Quarry*, for January. Ask for it.

Air Compressors **Diamond Drills** **Hammer Drills**

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"Standard" parts on your crusher assure maximum service.

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⚓S⚓ BRAND *The "Standard" brand on your material is an assurance of eventual economy.* ⚓S⚓ BRAND

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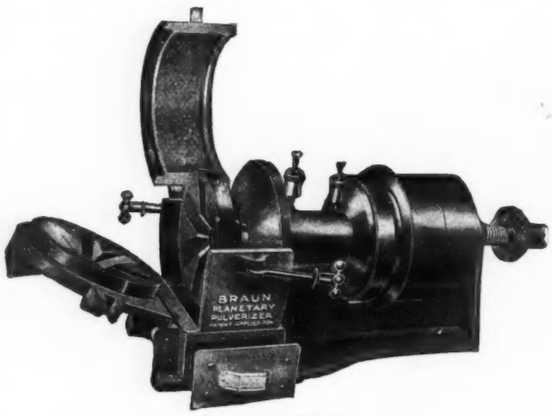
Steel Tires, Steel Tired Wheels, Solid Forged and Rolled Steel Wheels, Rolled Steel Gear Blanks, Steel and Iron Axles, Steel Springs, Steel and Iron Forgings, Steel and Iron Castings, Rolled Steel Rings, Steel Crusher Rolls and Shells, Steel Pipe Flanges.

The Braun Planetary Pulverizer

Is The Ideal Laboratory Grinder For

grinding all classes of material whether—hard—soft or talcy.



Patent applied for

A uniform product obtained *with one grinding.*

Capacity.

Quartz rock of medium hardness can be ground to 80 mesh—40 seconds—1 pound.

Has all the easy cleaning features of the regular Braun Pulverizer.

A simple planetary movement that cannot get out of order.

Send for descriptive matter.

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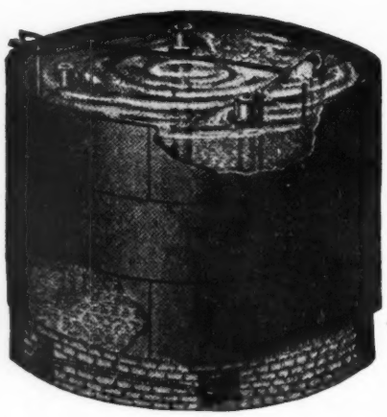
Distributed by leading dealers everywhere

THE BRAUN CORPORATION

LOS ANGELES, U. S. A.

THE PARRAL TANK SYSTEM OF SLIME AGITATION

Most Efficient—Most Economical—Simplest



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No Bridge or Side Structures
No Belts or Gears
No Interior Moving Parts
No Centrifugal Pumps

Agitation, settlement, decantation, dilution, re-agitation and water-washing in same tank or in any series of tanks designed by metallurgists.

No payment required until the system has been in commercial use for Sixty Days, when, if not satisfactory, it may be abandoned without any responsibility to the user.

Write for catalog and full particulars to

BERNARD MACDONALD

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1860

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ORE SMELTING EQUIPMENTS

ORE MILLING MACHINERY

1913

Perfect Sizing means improved concentration. It means increased crushing capacity, by preventing the return of already fine material to the crushing machinery. It means less production of slimes. The work of

The Impact Screen

is not perfect, but it comes considerably nearer being so than that of any other machine. It brings the advantages enumerated above, and they are advantages worthy of the serious consideration of every mill operator.

Send for Pamphlet 9-B.

Colorado Iron Works Company

Denver, Colo., U. S. A.

DEISTER MACHINE COMPANY

Home Office: Shoaff Bldg., Fort Wayne, Ind.—Inc. July, 1912—London Office: Salisbury House, London Wall, E. C.

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DEISTER INVENTIONS

SUBSEQUENT TO JANUARY 1st, 1912, IN ADDITION TO OTHER PATENT RIGHTS

EMIL and W. F. DEISTER, PATENTEES

2 YEARS' CONTINUOUS EXPERIMENTING HAS DEVELOPED

DEISTER MACHINE COMPANY'S

Double Deck Sand Table ← Patented → **Double Deck Slime Table**

Single Deck Sand Table ← Patented → **Single Deck Slime Table**

(Latest Ideal Head Motion used on above Reciprocating Machines)

Multiple Deck Tilting Slimer ← Patented → **For Finest of Slimes**

(Built as six or twelve deck machine)

Classifier ← Patented → **For Coarse and Fine Sands**

EACH OF THE ABOVE MACHINES HAS BEEN THOROUGHLY TESTED AT THE MIAMI COPPER COMPANY AND HAS IN ACTUAL TEST DEMONSTRA ED ITS SUPERIORITY.

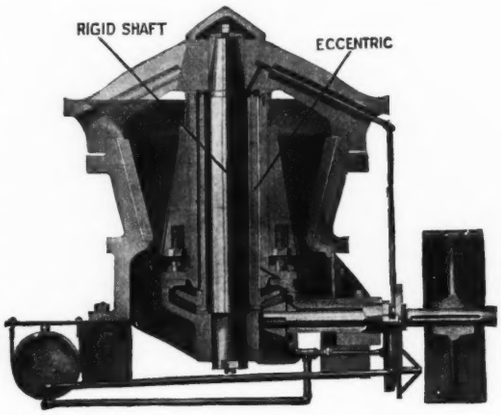
WRITE FOR CATALOG ***Full data sent on request***

SPEAKING OF THE FEDERAL MILL—

In the Engineering and Mining Journal of July 5th, 1913, page 10, Claude T. Rice says:—

"The ore goes directly to the Symons (Telsmith) 7½ C gyratory crusher used in each section. The feature of the Symons coarse crusher is the fact that the crusher head itself does not rotate, but is pushed straight in and out by an eccentric sleeve that is carried on the rigid shaft of the crusher head. Owing to the fact that the eccentric causes the movement of the head through direct contact with it, the movement of the crusher head is as much at the top as at the bottom. Consequently, there is a better gripping of boulders and a quicker breaking of them with this gyratory when they approximate the maximum feed for the crusher than in the case of the gyratory-shaft type."

Reprint of Mr. Rice's article on request.



To avoid confusion with a reduction crusher of the same name, this machine is now called the Telsmith Primary Breaker. It is the same efficient machine that has done such remarkable work for Mr. Guess at Flat River. May we send you our catalog No. 168, describing it?

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CHEAPER—DRYER CAKES

Our Record is: ALL of our many installations are complete successes.

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210 FELT BUILDING
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Strong

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WESTERN STOPING DRILL No. 5

Has only 15 parts—all steel—weighs only 72 lbs. Cylinder case hardened—hammers accurately ground. Uses less air—easier for the miner to handle—does more work.

Write for Catalog 105—NOW.

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SALES AGENTS: Wood Drill Works, Paterson, N. J. The Scandinavia Belting Co., 125 White Street, New York City.

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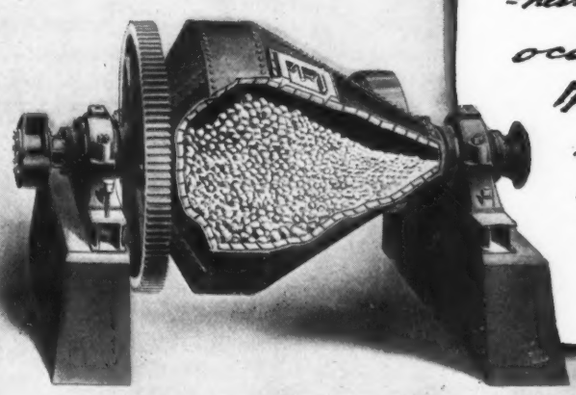
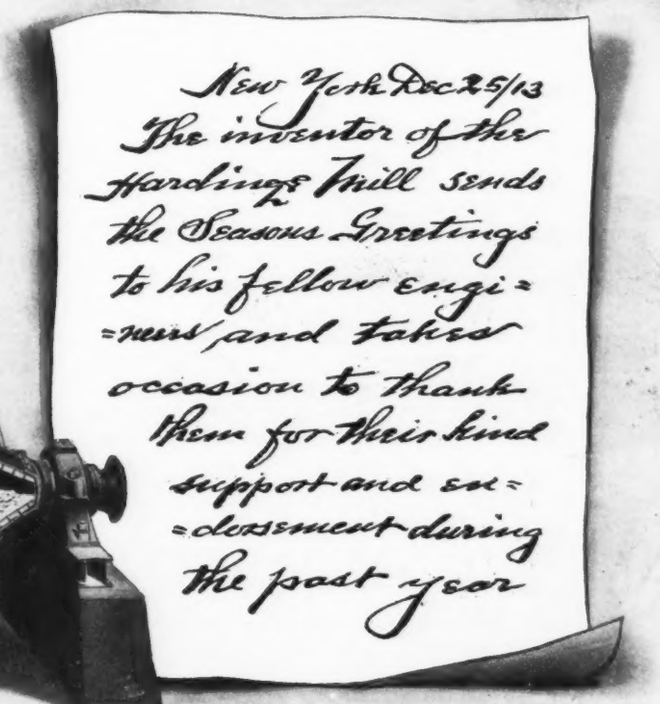
CONICAL MILL CO.

50 CHURCH STREET
NEW YORK

Cable Address: Hallharding, New York. London: 563 Salisbury House





Local Sales Agents

Denver, Colo.—Hendrie & Bolthoff Mfg. & Supply Co. Salt Lake City, Utah—Mine & Smelter Supply Co.

Announcement

The Continuous Zinc Furnace Company, owners of the Johnson Electrothermic Process for smelting complex zinc sulfides, making spelter, a fusible slag, copper matte and base lead bullion in one operation, are prepared to grant a license to one concern to build a commercial unit at a place commercially well located.

This company is building at its Hartford plant a unit large enough to demonstrate its claims, which unit will be in operation January 1st, 1914. A limited number of properly-introduced engineers are invited to watch the operation.

Our process is as near as practicable a finished invention, and we intend to "show" people.

"The proof of the pudding is in the eating thereof." How is your appetite?

The Continuous Zinc Furnace Co.

W. McA. Johnson, Pres.

599 Broad Street, Hartford, Conn.

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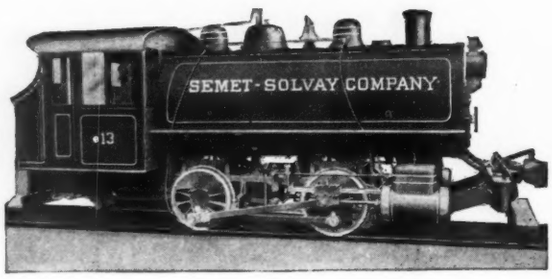

Locomotives on trunk line railroads have the advantage of the best facilities for inspection and repairs.

Industrial locomotives face different conditions. They must work day after day in the hardest service, and often in localities where repairs cannot be made without great inconvenience.

Our 78 years' experience in building locomotives, both large and small, is invaluable in connection with the design of smaller ones in order to insure reliability, which is the main question in industrial work. You know what delays cost you.

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N. B. Livermore & Company, Los Angeles and San Francisco, California.

AMERICAN BRIDGE COMPANY OF NEW YORK
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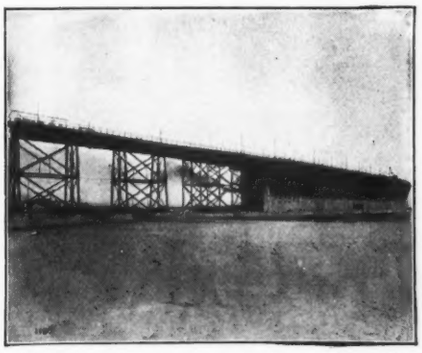
Manufacturers of Steel Structures of all classes particularly **BRIDGES AND BUILDINGS**



Ore Dock and Approach for Northern Pacific Railway, Superior, Wis.

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U.S. Steel Products Co., Pacific Coast Dpt.
SAN FRANCISCO, CAL., Rialto Building
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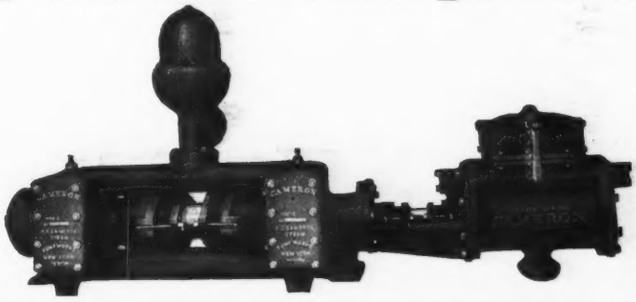
The Slogan of the Cameron—"Character: The Grandest Thing"



This Cameron Pump Built to Withstand Gritty Water

If you have had trouble with pumps that have suffered from the wearing qualities of gritty water, then get satisfaction with this Cameron Outside-Packed Plunger Pump.

It is much more durable than a piston pump.

The water-end has no wearing parts except the packing in the stuffing boxes which can be instantly adjusted from the outside. There are no rods, arms or working parts exposed to rust or damage. The plunger is supported in stuffing boxes, and cannot sag or get out of line at the end of the stroke.

There's a Cameron Pump to overcome every pumping difficulty. Get the right type for your purpose. Write for Bulletin No. 7 showing many types of Cameron Pumps and giving valuable information.

A. S. Cameron Steam Pump Works
11 Broadway, New York

12-27-13

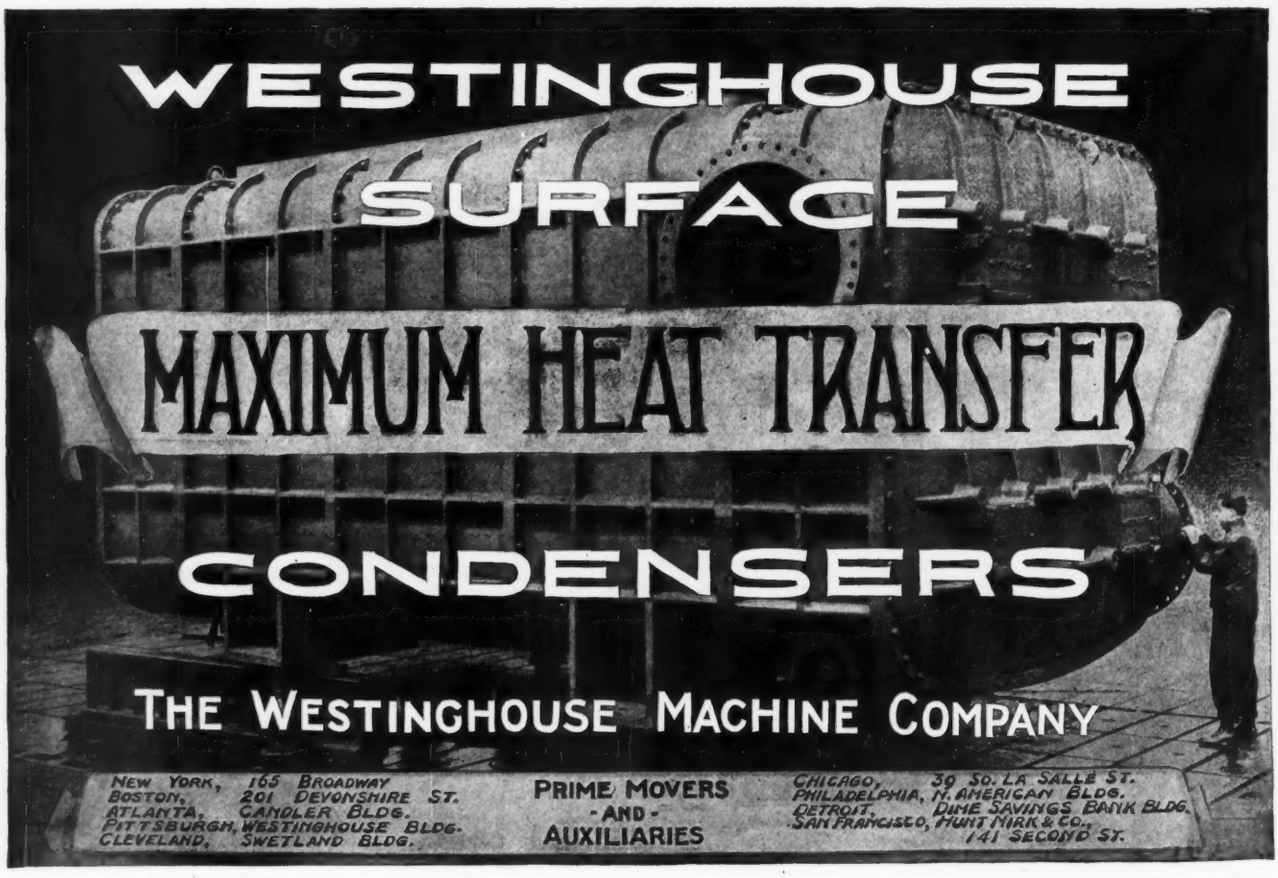
We Manufacture Concentrating Tables for Every Purpose

Our devices are guaranteed to be the most efficient on the market for either the coarsest sands or the finest slime overflows.

Write for our new catalog just from the press.

The Deister Concentrator Company

Fort Wayne, Indiana



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Americore Rubber Covered Wire

Mauran, Russell & Crowell, Architects. **Railway Exchange Building, St. Louis.**

OVER 700,000 feet of our best grade rubber covered wire used in this building.

Every foot is carefully inspected by us in the various stages of manufacture, and when completed is finally examined and labeled under the direction of the Underwriters' Laboratories.

We are prepared to furnish this wire in all sizes and conductors, both solid and flexible, from warehouse conveniently located for quick delivery to all parts of the country.

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The Blue Center

of **Roebling** Improved Plow Steel Rope does not look blue as shown on this page but it is always blue in the rope. It is made so as to distinguish this from other wire ropes.

Roebling Improved Plow Steel Rope is just what its name implies—rope made of **improved** plow steel—steel which has been developed from the best and latest methods of manufacture. It will stand heavy pulls and hard knocks better than any other.

John A. Roebling's Sons Co.

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Warehouses with Stock: New York Philadelphia Pittsburgh
Chicago Cleveland Savannah San Francisco
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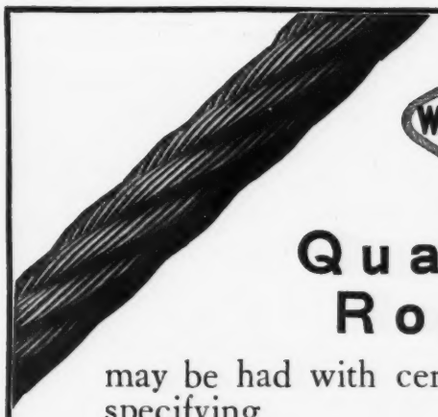

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FOUNDED 1816

Quality Rope

may be had with certainty by specifying

WATERBURY

Waterbury Ropes, both Wire and Fibre, have earned an enviable reputation for quality and long service.

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Wire Rope—Manila and Sisal Cordage—Fibreclad Wire Rope

WANTS

Positions Wanted, three cents per word, each insertion
Positions Open, five " " " " "

POSITIONS OPEN

Wanted—Expert concentrator man for disseminated lead ore; must be technical man having practical experience with jigs, tables, classifiers, slime treatment, etc. Reply giving references and experience and state age, education, whether married or single and salary expected. Address P. O. 554, care Engineering and Mining Journal. Jan. 3.

Wanted—Mill superintendent for Norway; for a Norwegian born engineer with long experience as mill superintendent, accustomed to supervising a jig mill in every detail; position open at a mine near the coast in the south of Norway from March, 1914, or earlier. Application with statement of age, education, experience, salary requested, if married, if Norwegian citizen send to A/S Stordö Kisgruber, Stord, Norway. Jan. 3.

If you recognize the value of approved specialties in an engine and boiler room as a means of higher efficiency; if you believe in this sort of thing to the extent that you think you could sell a well known boiler specialty in your territory for an old established manufacturer in the power plant field, write and tell us all about yourself; on receipt of your letter we will outline our proposition in full. Address P. O. 555, care Engineering and Mining Journal. Dec. 27.

POSITIONS WANTED

Master mechanic open for engagement; experience in power house, smelting, mining and milling machinery. Address P. W. 567, Engineering and Mining Journal. Dec. 27.

Metallurgist, experienced in design, installation and operation of cyanide plants, desires position; salary reasonable. Address P. W. 558, care Engineering and Mining Journal. Dec. 27.

Cyanider, experienced as superintendent designing and installing; trained modern operator, wants position at reasonable salary. Address P. W. 573, care Engineering and Mining Journal. Jan. 17.

Engineer with Butte and Cœur d'Alene training and varied executive experience in Colorado, Nevada and Utah, retired through reorganization, open for engagement. Address T. W. Bowen, Newhouse Bldg., Salt Lake City. Dec. 27.

Master mechanic, 20 years' practical experience, technical education, desires position at mines, mills, blast furnaces, smelters, etc., large plants where highest efficiency is demanded. Address P. W. 572, care Engineering and Mining Journal. Jan. 10.

Open for engagement; a technical man for mine or mill superintendent; experience in iron mining, underground limestone quarrying and cleaning of iron ore a specialty; married and can give the best of references. Address P. W. 570, care Engineering and Mining Journal. Jan. 3.

Accountant and bookkeeper, age 32, desires position; ten years' experience with mining companies and contractors; thorough knowledge of bookkeeping, pay-rolls, costs and all duties connected with mine office. Address P. W. 566, care Engineering and Mining Journal. Dec. 27.

Mining engineer, 16 years' practical experience in mining and milling, wants change; last 12 years engaged as superintendent, manager and examining engineer of properties working large and small crews in States and Mexico; speak English, German and Spanish; willing to go almost anywhere; good health; reference. Address P. W. 571, care Engineering and Mining Journal. Jan. 3.

Mining engineer, technical graduate, ten years' practical experience with last five years in executive positions desires engagement; advertiser is experienced in mining, ore dressing, examination, mine development and details of management; desires position with future in management or examination. Address P. W. 565, care Engineering and Mining Journal. Dec. 27.

Practical American miner leaving Mexico on account of political conditions, wants position in South or Central America, as foreman or shift boss, speaks Spanish and thoroughly understands native labor, specialty deep shafts, uptodate methods, low costs, "no booze fighter," married, age 37, references, offer me something. Address P. W. 574, care Engineering and Mining Journal. Dec. 27.

By reason of demands of the Trustees of estates holding claims against the Glasgow & Western Exploration Co., Limited, that company has been put into liquidation in Scotland, and Mr. William Lamont of 33 Renfield St., Glasgow, has been appointed liquidator.

The main assets of the company in question are the following copper properties: The Montreal Mine, Beaver County, Utah, and the Copper Canyon Mine and the Copper Basin group situated in Lander County, Nevada.

To facilitate a realization of these properties a comprehensive report has been prepared, and correspondence is solicited from substantial mining interests.

Communications should be directed to

Joseph Ralph, Assoc. Inst. M.M.,
Attorney-in-Fact for the Liquidator
The Glasgow & Western Exploration Co., Ltd.
416 Walker Bank Building,
Salt Lake City, Utah.

COMPLETE POWER PLANT at a BARGAIN

1—85 H.P. De La Vergne crude oil engine, Type H.A., which developed 99 H.P. on actual test in New York.
1—Generator, 40 kw. at 1085 r.p.m., 250 v., 160 amp., Type CCD.
1—Motor, 26 h.p. at 1025 r.p.m., 230 v., 95 amp., Type CM.
1—Motor, 13 h.p., at 1100 r.p.m., 230 v., 49.5 amp., Type CM.
1—Motor, 5 h.p. at 1000 r.p.m., 230 v., 19.5 amp., Type CM.
1—Motor, 5 h.p. at 1575 r.p.m., 230 v., 20.2 amp., Type CM.
1—Duplex Pump, 3½"x4" Stroke, Double Acting Fairbanks-Morse.
Switchboard, ammeter, volt meter, rheostats, etc., etc., for the above.
This electrical equipment is of the well known and reliable Crocker-Wheeler make, Direct Current Type. 1 Hoist 5000 lbs. capacity (Denver Engineering Works) complete with D.C. Motor and about 500 ft. of ½" round cable.
For further information, prices, etc., address **Box 296, Tonopah, Nevada**

YOU CAN'T LOOK INTO THE EARTH

but we can get you a large clean core of all strata under your land to be examined in broad daylight. No guess work.

THE J. A. BRENNAN DRILLING CO.

Home Office— Scranton, Pa.
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MAXECON MILL A Grinder for all kinds of ores
Especially adapted for grinding ores for **CYANIDING**
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1—10" by 14" Steam Hoist.
1—5' overhead drive Huntington Mill.
2—5' under drive Huntington Mills.
2—No. 2 Dodge Rock Crushers.
I have a complete line of Mill and Mining Supplies.
Send for stock sheet.
D. J. McMASTER, 1112 to 1120 Folsom St., San Francisco, Cal

HOMESTAKE MINING COMPANY
704 West Coast Life Building **San Francisco, Cal.**

The San Francisco fire destroyed the Company's records. We are endeavoring to complete a set of the annual reports and have secured all except those for the following years:
June 1, 1881 to June 1, 1882
June 1, 1886 to June 1, 1887
June 1, 1889 to June 1, 1890
If you have such reports or any of them, will you please communicate with us.

C. G. HUSSEY & CO.
Rolling Mills and Office PITTSBURGH, PA.
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Sheet Copper, Bottoms, Roll Copper, Tinned and Polished Copper, Nails, Spikes, Rivets, Conductor Pipe, Eaves Trough, Elbows, Shoes, Mitres, etc.
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Dynamite made on the ammonia and straight nitroglycerin formulae, and in the regular and (E. L. F.) Extra Low Freezing grades

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HERCULES POWDER CO.

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An Expert's Opinion on Corrosion

"The Sulphurette and Its Finish" is a little book written by a man who's wise to the cause of corrosion in the mine. He tells a remedy, too.

Want this book? It's free—just write.

HIGHLAND CHEMICAL PRODUCTS CO.
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Ruggles-Coles Ore Dryer.

Avoid the Bugaboo

of "moisture deduction" by drying your ores at the mine. Over 36 Ruggles-Cole Dryers are now being used for this purpose for they have been found to effect a large saving.

Drying of ore at the mine means saving in freight; elimination of difficulties of handling frozen ore; and the avoiding of the danger of furnace explosions.

Ruggles-Coles Double Shell DRYERS

have stood up to the work placed upon them where previously other dryers have failed. The reason for this is that they are designed on the correct principle and the highest class of workmanship and material is put into their construction. The Ruggles-Coles "Double Shell" Dryer is designed not to be sold in competition with others but to dry at the lowest ultimate cost scores of organic and inorganic materials.

Shall we send you booklet "What We Dry?"

Ruggles-Coles Engineering Co.

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The Knox Coupling Cannot Blow Off Under Highest Pressure

Why not use the Knox Drill and Mining Machine Coupling? The Knox is the only coupling that will not injure the hose or blow-off under high pressure. The clamps extend beyond the end of the stem, sustaining the hose at that point and preventing it breaking sharply over the end of the stem. Resetting of couplings reduced to the minimum.

Just Sign This Coupon

Get One FREE

Knox Mfg. Co., Philadelphia, Pa.

Send us a Knox Coupling, size ..... inch with clamp to fit hose measuring ..... inches outside diameter.

Name of company .....

Address .....

Requested by .....

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The Knox is mechanically correct and costs less than other high class couplings. Sizes ½″ to 3″, spuds with standard pipe thread. Try out the "KNOX" and side-step your hose troubles. We'll meet you more than half-way by furnishing a coupling without charge. Just forward the coupon and leave the rest to us.

Do it now.

Knox Manufacturing Co., Inc.

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FOR ALL PURPOSES
ESTABLISHED 1857
A. LESCHEN & SONS ROPE CO.
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We make the most complete line in the world. Hand Power, Horse Power, Gasolene, Steam, Air, Electricity, Hydraulic Feed, Screw Feed.

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So improved from time to time in Flexibility—Weight—Couplings that the objections originally offered against an Armored Hose have been overcome.

A list of Satisfied Customers speaks for itself.

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Main Offices:
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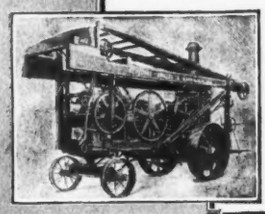
Branch Offices in Principal Cities.

KEYSTONE CABLE DRILLS



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WELL DRILLING MACHINES

Over 70 sizes and styles, for drilling either deep or shallow wells in any kind of soil or rock. Mounted on wheels or on sills. With engines or horse powers. Strong, simple and durable. Any mechanic can operate them easily. Send for catalog.

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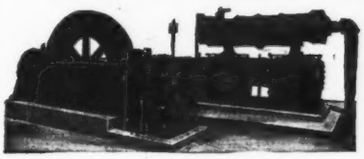


Bury 3-Cylinder Variable Volume Air Compressor; Patented—Making a new world's record.

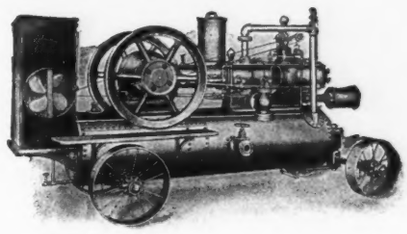
See full page June 21 issue (page 6).

Bury Compressor Co.
Erie, Pa. U. S. A.

THE LAST WORD IN PORTABILITY

Compressed Air

WHEN YOU WANT IT
WHERE YOU WANT IT
AS YOU WANT IT



Chicago Pneumatic Tank Mounted Gasoline Driven Air Compressor

The truck type of portable compressor is intended especially for field work, in the construction of bridges, elevated tracks, buildings, tanks and pipe lines, also for prospecting, quarrying, road building, foundation work, sand blast cleaning, paint spraying, applying cement coating, or wherever a compact, durable and powerful unit is required.
300 sizes and styles—Steam, belt, gear, gasoline and direct motor drive.

Chicago Giant Rock Drills, and Plug Drills in all capacities.

Send for Bulletins—Address Dept. R.

Chicago Pneumatic Tool Company

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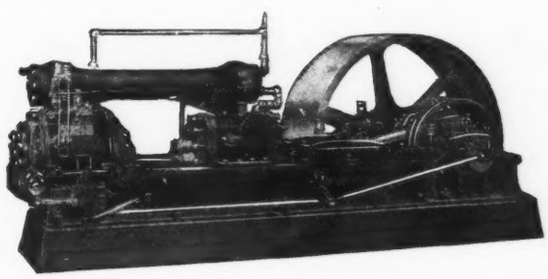
Automatic Selective Proportional Unloaders

are found exclusively on the



Norwalk Compressor

These improvements mark a new era in compressor construction. They gain the instant and favorable attention of all skilled engineers. ¶ For the usual hackneyed claims of *economy, durability* and *efficiency*, let our forty years' experience be an assurance of adequate and discerning attention to every feature.

The Norwalk Iron Works Co.
South Norwalk, Conn.

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High Efficiency Engines for Mines and Smelters

Corliss Engines **Poppet Valve Engines** **Uniflow Engines** **Air Compressors** **Hoisting Engines**
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NORDBERG MANUFACTURING COMPANY **MILWAUKEE, WISCONSIN**

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A MOUNTED DIAMOND DRILL

Gasoline Driven!

Think it over. The economy and convenience of gasoline drive; the many advantages of **complete** drill, engine and all, mounted on truck ready for immediate transportation anywhere. It's a new one and fills a real need. **Better send for full description.**

E. J. Longyear Co. **Minneapolis, Minn.**

McKiernan-Terry Drill Company

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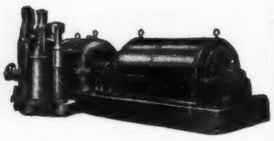

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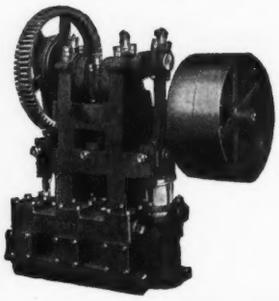

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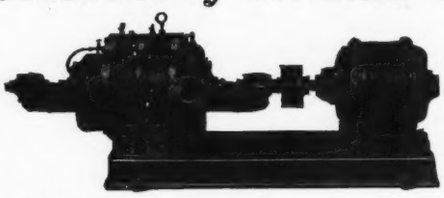

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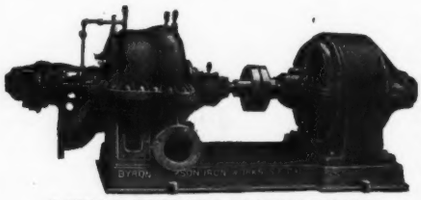

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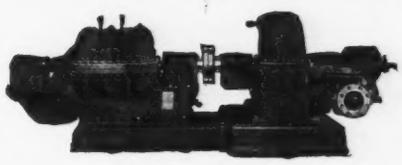

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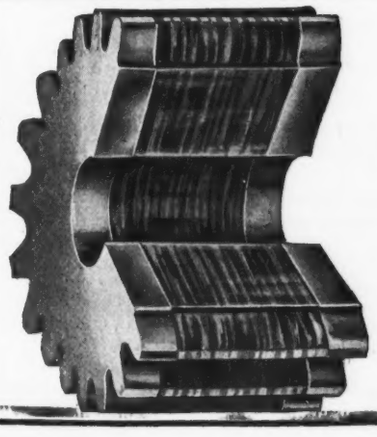

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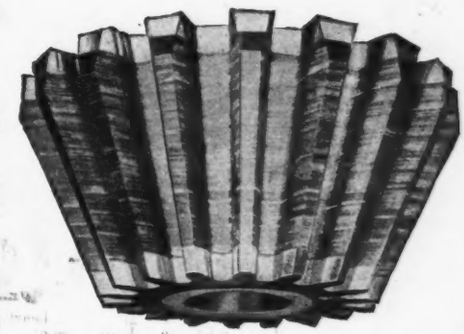

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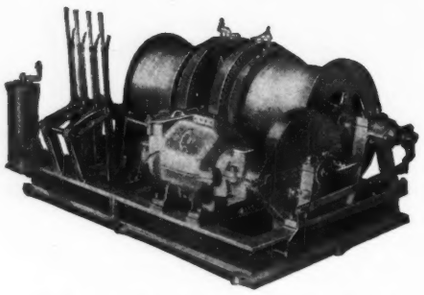

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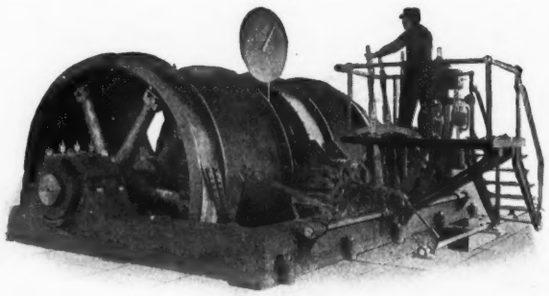

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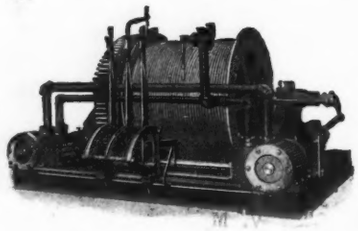

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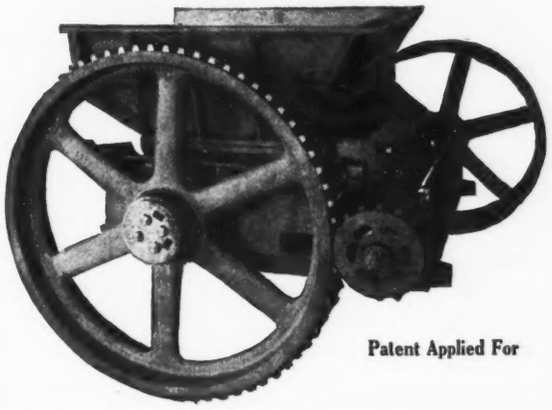

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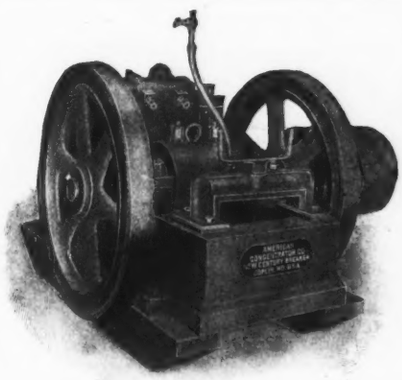

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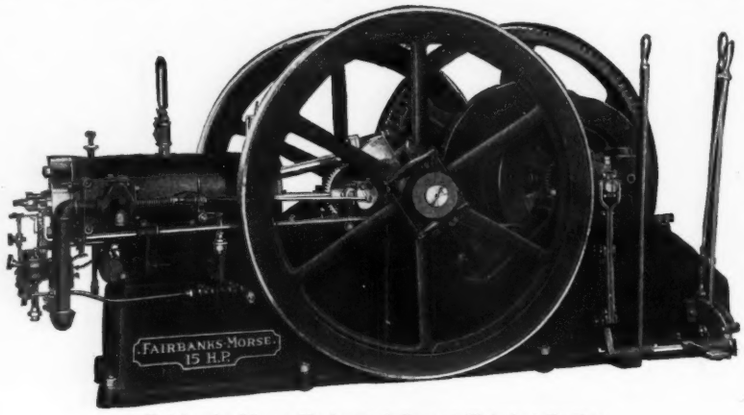

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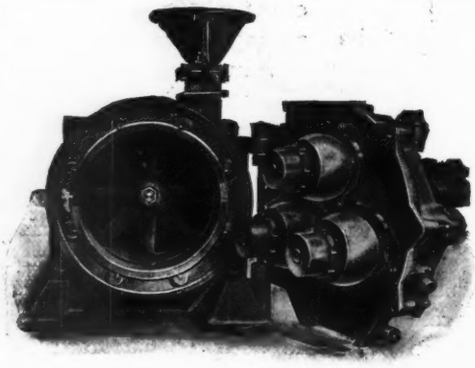

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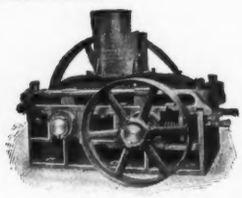

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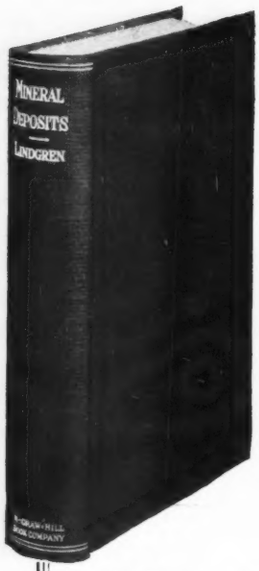

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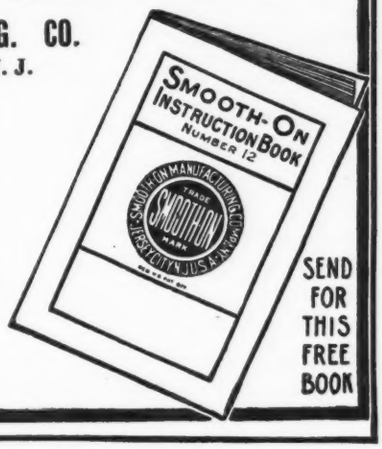

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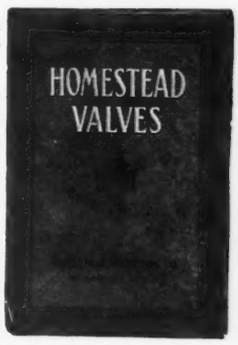

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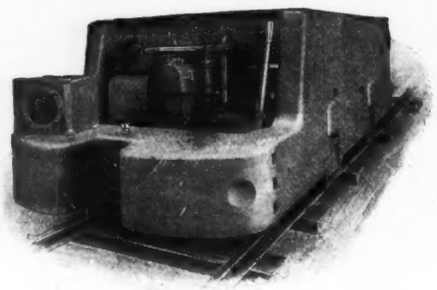

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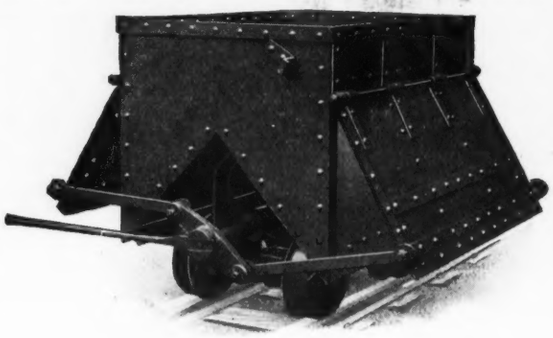

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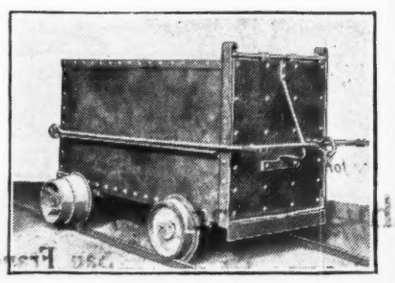

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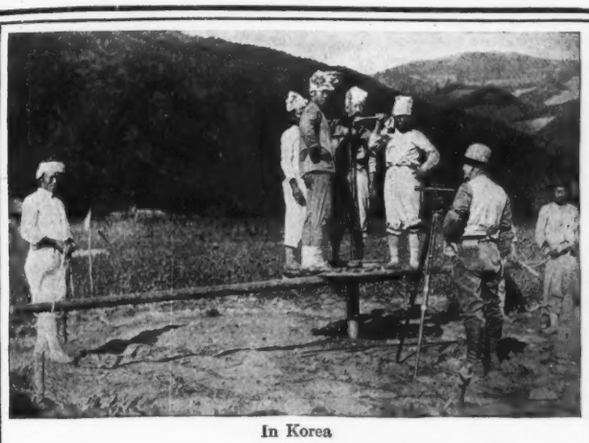

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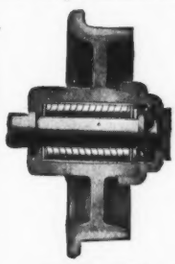

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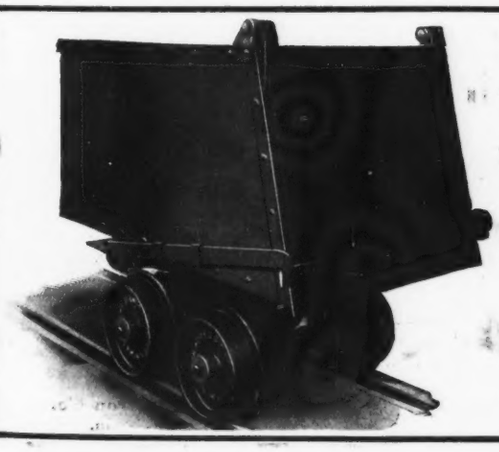

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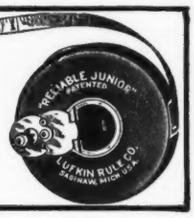

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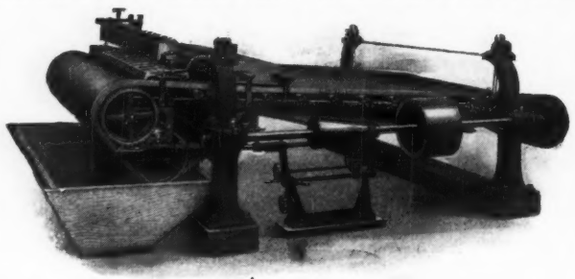
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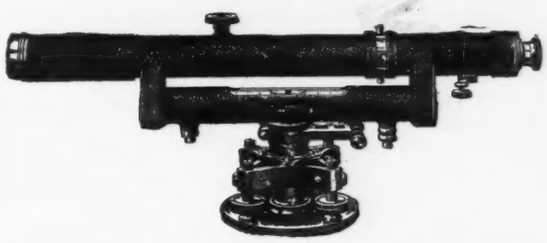

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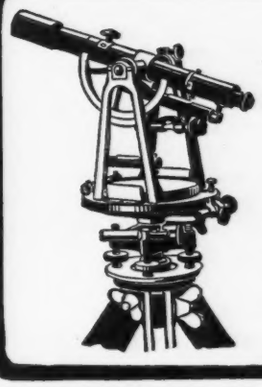

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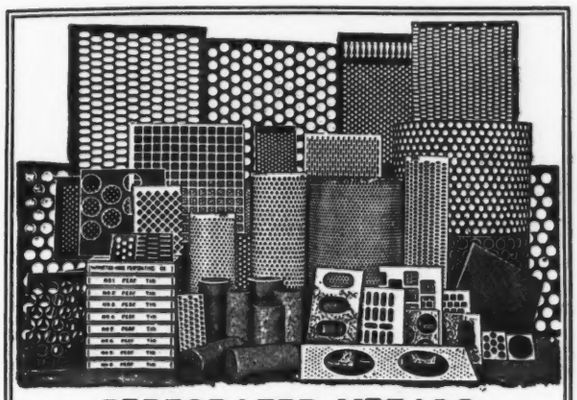

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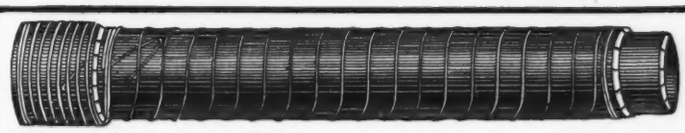

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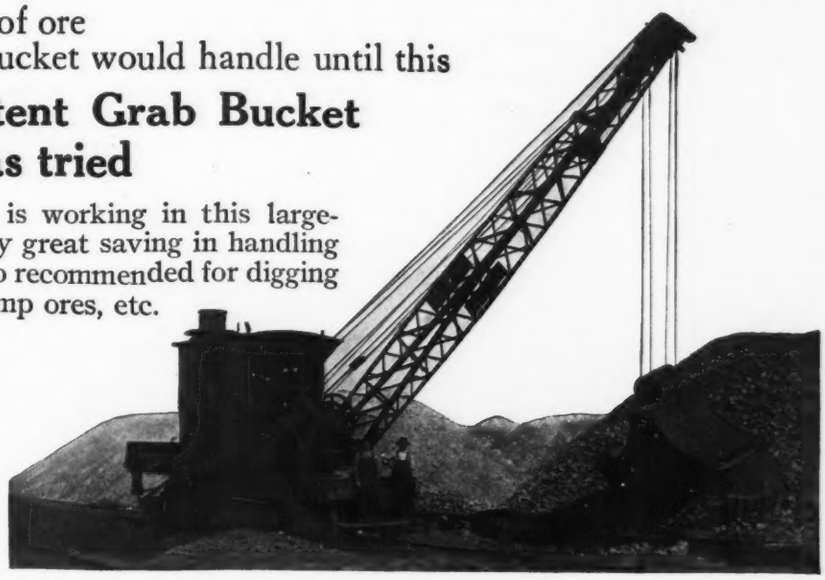

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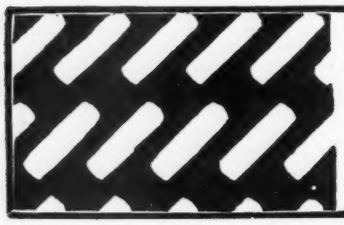

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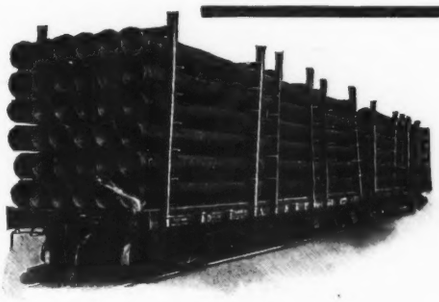

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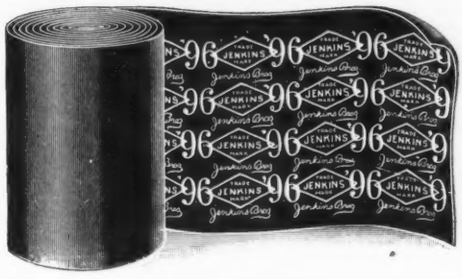

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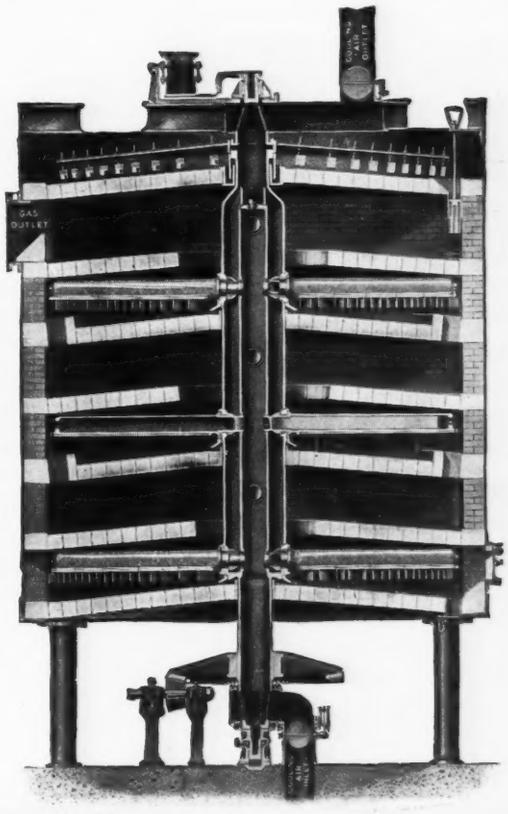

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